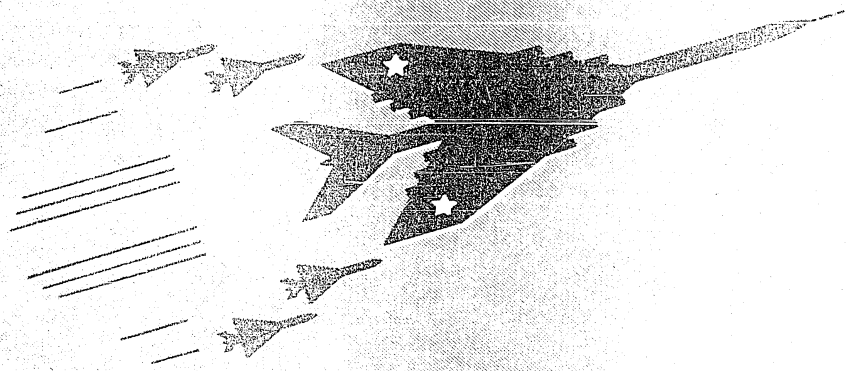
TRANSLATION

HERALD OF THE AIR FLEET



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1960

EXPLANATORY NOTE

This publication is a translation of Herald of the Air Fleet, (Vestnik Vozdushnogo Flota) a monthly journal of the Soviet Air Force published by the Military Publishing House, Ministry of Defense, USSR.

Every effort has been made to provide as accurate a translation as practicable. Soviet propaganda has not been deleted, as it is felt that such deletion could reduce the value of the translation to some portion of the intelligence community. Political and technical phraseology of the original text has been adhered to in order to avoid possible distortion of information.

AIR TECHNICAL INTELLIGENCE TRANSLATION

(TITLE UNCLASSIFIED)

HERALD OF THE AIR FLEET

(Vestnik Vozdushnogo Flota)

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AIR TECHNICAL INTELLIGENCE CENTER
WRIGHT-PATTERSON AIR FORCE BASE
OHIO

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THE LOFTY MISSION OF THE SOVIET SOLDIER

Forty-two years have passed since the workers and peasants of our country, led by the Communist Party, have accomplished the Great October Socialist Revolution, created their own armed organization - the Soviet Army. While defining its historic purpose, Vladimir Il'ich Lenin said that it was called upon to guard, from all and every kind of enemies, the achievements of the proletarian revolution, the government of the people, its peaceful creative labor directed toward the construction of a Communist society. "The socialist army", emphasized Lenin, "upholds it cause, its land, its rule in the factory, and defends the government of the workers".

Flesh and blood of its people, the Soviet Army is rightfully called the army of a new type. For the first time in the history of human society an army began serving, not the aims of aggression, suppression, and enslavement, but the vital interests of the workers and the defense of their Fatherland which is the stronghold of the peace and security of peoples. These noble and just aims, these indissoluble ties and unity with the people determine the boundless power and potentialities of our Army. Its tried organizer, leader and indoctrinator is the wise Communist Party, and herein lies the main source of might of the Armed Forces of the Soviet Union.

The whole history of the Soviet State confirms the fact that the only purpose of its army is the defense of the country against military aggression by the imperialist powers and the protection of the socialist achievements and peaceful labor of its people. This follows from the very essence of the Soviet Government. The state of the workers and peasants came into being under the banner of ideas of peace and friendship among peoples. The decree on peace signed by the hand of the leader of the Revolution was the first legislative act of the Soviet Government. The Leninist principles of peaceful coexistence in relations with other states, regardless of their social and economic systems, underlay and underlie the external policy of the Communist Party and the Soviet State.

By serving whole-heartedly the Socialist Motherland and the cause of the Communist Party, the Armed Forces of the USSR have gained the universal love of the people. The unparalleled selfless struggle of the young Soviet Army and its outstanding victories over the united forces of external and internal counterrevolution in civil war will never be forgotten.

The personnel of the Army, Air Force, and the Navy worthily and honorably fulfilled their historic mission in the subsequent period as well, in the years of

peaceful construction. In those years the Soviet Union was the only socialist state in the capitalist encirclement. More than once our glorious Army had to rebuff resolutely the provocative attacks of enemies, while guarding the inviolability of the borders of the USSR.

Immortal through the ages is the titanic feat of the Soviet Armed Forces in the Great Patriotic War. The memory of our people and of all progressive humanity will forever retain the crystal-clear image of the Soviet soldier as a fighter and as a man filled with a sense of lofty humanism and who gave all that he could to rid the earth of the Fascist plague, of Hitlerite enslavement.

Covered with the glory of heroic victories, the Soviet Armed Forces are celebrating their 42nd Anniversary. As ever they vigilantly and indefatigably continue to stand their honor guard, while guarding what is most sacred — peace and happiness, the creative labor of the peoples.

The traditional celebration of Soviet Army and Navy Day takes place this year as our Motherland is flourishing mightily.

Eloquently bespeaking this are the results of the development of the national economy during the past year. According to the report of the Central Statistics Department of the Council of Ministers of the USSR, the volume of industrial output has grown more than 11 percent in comparison with 1958. In excess of the annual quota, industrial production has amounted to almost 50 billion rubles. Great successes have been obtained by the toilers of our agriculture.

Soviet scientific and technical thought achieved new outstanding victories. Recently, as appears from the reports of TASS, a successful test was conducted for a more powerful multistage ballistic rocket, designed for launching heavy earth satellites and the realization of cosmic flights to the planets of the solar system. The whole world admires the precision of calculations: the rocket traveled a distance of 12.5 thousand kilometers, and the deviation of the point of fall of the rocket from the computed one was less than two kilometers.

All of this vividly attests to the steady growth of socialist economy and the flourishing of science.

In the year of 1960 just begun, the Soviet Union will take a new great stride along the path towards its objective. During the current year the gross production of industry must increase by 8.1 percent. It is certain that the planned quota will be overfulfilled. Steel smelting will reach almost 65 million tons. The production volume of light industry will increase by about 9 billion rubles.

Inspired by the decisions of the December Plenum of the Central Committee of the CPSU which outlined specific measures for further development in agriculture, the toilers of rural areas strive to see that the gross collection of grain during the second year of the seven year plan reaches 9.3 billion poods. The production of meat is approaching 10.6 million tons (slaughter weight). It is planned to obtain 72 million tons of milk, or 336 kilograms per capita of population, as against the 330 kilograms obtained by the USA in 1958.

The rapid rates of economic development of the USSR will ensure the fulfillment of the seven year plan ahead of time. The course of historic development clearly shows that in peaceful economic competition between two systems, the more progressive and viable socialist regime will win the victory.

Recently the fourth session of the Supreme Soviet of the USSR passed an act of the greatest historic significance. Having discussed the report by Comrade N. S. Khrushchev "Disarmament - a Road to Securing Peace and Ensuring Friendship Among Nations", the Supreme Council of the Union of the SSR unanimously passed a law providing for a considerable reduction of the Armed Forces of the USSR. The strength of the Armed Forces is being further reduced by another 1 million 200 thousand men, and after this our Army and Navy will number in strength 2 million 243 thousand men.

The Communist Party of the USSR, undeviatingly carrying out the Leninist policy of peace, persistently and consistently fights for a relaxation in international relations and for ridding the nations of the threat of new war. The conclusion was reached at the XX and the XXI Congresses that there is no more fatal inevitability of wars under the present situation, and that it is possible and necessary to eliminate war forever from the life of human society. A clear road to this objective is universal and total inspected disarmament, the program of which was introduced for consideration in the United Nations Organization on 18 September 1959 by the head of the Soviet Government, Comrade N. S. Khrushchev during his historic visit to the USA.

Now on the eve of the critical international conferences at which this program will be considered, the Soviet Union has made a decision for a further reduction in its Armed Forces. It does this on its own initiative, as a unilateral action, without waiting until its partners in negotiations finally put an end to endless debates on disarmament.

"We accept a reduction in our Armed Forces because", said N. S. Khrushchev at a session of the Supreme Soviet, "we do not want war, because we do not intend attacking anyone, do not wish to threaten anyone and have no predatory aims."

The very fact that the Soviet country is now going through a period of unprecedented rapid development in its national economy constitutes the basis for our firm conviction of the correctness of the step taken, the new considerable reduction in the Armed Forces of the USSR as a unilateral action. This conviction is based on the indestructible moral and political unity of the Soviet society. The development of our economy, the achievements of scientific and technical thought - this is what created the conditions favorable to the reduction in the Armed Forces. Passing a law of the greatest historic significance, the Supreme Council of the USSR also took into consideration the fact that the mighty socialist camp, steadily strengthening and growing, now is a strong bastion of peace.

Progressive people throughout the world justly evaluate the new outstanding contribution of the Soviet Union in strengthening the cause of peace, its new peace-loving initiative. No subterfuges of false imperialist propaganda are able to diminish the great international significance of the law passed by the Supreme Soviet for a further considerable reduction in the Armed Forces of the USSR and the appeal to the parliaments and governments of all the states of the world to respond to the call for the new peace movement of the Soviet Union to undertake, for their part, practical measures directed toward a reduction in existing armed forces.

As for those who did not profit by the convincing lessons of history and who continue nurturing aggressive plans with regard to the USSR and the states of the socialist camp, they have all received a frank and clear warning: the numerical reduction of the Soviet Armed Forces not only will not diminish their fire power,

but on the contrary, this power will increase qualitatively many times.

Due to the successes of Soviet scientists, engineers and workers engaged in the defense industry, our Army has at its disposal the newest and the most modern types of armament - rockets and nuclear weapons. These weapons are being perfected and will further be perfected until they are banned.

The Soviet Army is armed with a sufficient quantity of ballistic rockets of various types, including operational-tactical ones with an effective range of from tens of to several hundred kilometers, as well as strategic rockets, including the intercontinental missiles with a practically unlimited range. Thus rocket troops under present-day conditions have become a major branch of the Armed Forces of the USSR. At the same time, the Party and the Government proceed from the fact that the successful conduct of military operations even in a modern war is possible only on the basis of a coordinated application of all means of armed combat and the combined efforts of all types of armed forces. Therefore the Soviet Government retains a certain number of and a corresponding reasonable proportion in all types of armed forces. Their constant combat readiness and high vigilance make it possible at any time to deal a crushing, retaliatory blow against any aggressor.

Filled with pride for their beloved Motherland and their people, the soldiers of the Army, Air Force and the Navy unanimously welcome the decision made by the Supreme Soviet for a further considerable reduction in the size of the Armed Forces. At the conferences and meetings of the personnel, meetings of Party aktivs conducted in the units and groups of the Air Force, the aviator-fighters warmly approve the measures of the Soviet Government, express their aspiration to serve the Fatherland even better, to perfect combat skill, and more persistently to master the equipment and weapons intrusted to them.

Each aviator is deeply conscious of the fact that the historic peaceloving step taken by the Soviet Government will enhance the international prestige of our Motherland even more, will extend the scope of the struggle of progressive forces for disarmament even further and for strengthening peace and security in all the world.

The reduction of the Armed Forces by one third and decreasing the expenditures for military needs according to the government budget of the USSR will yield an appreciable economy in material resources. All of this will be an additional reinforcement for considerably overfulfilling the plans of the national economy. In the soldiers who will be put in the reserves the socialist industry will obtain valuable workers.

Let us take, for example, the aviators. The officers of the Air Force — be it a commander or a political worker, a pilot or a navigator, an engineer or a technician, an instrument specialist or a technical landing facilities specialist, a worker in the Air Force rear or repair shops — by an overwhelming majority they all possess high moral and political qualities and organizational abilities. At the same time they constantly deal with the most up-to-date and complex equipment and have gained practical habits in handling it.

A good number of our combat comrades, having left the control sticks of aircraft, are successfully working in plants and factories, in mines, in kolkhozes and sovkhozes, in transportation, and fly the air routes of civil aviation.

The Soviet man is filled with peaceful aspirations and creative plans. However, he is not only able to work well, but also to guard his home from plunderers and invaders. The peaceful labor of our people is guarded vigilantly and indefatigably,

as before, by the glorious Soviet Armed Forces which have all that is needed to utterly defeat any aggressor.

Celebrating the 42nd Anniversary of the Soviet Army and Navy, the soldiers of the Air Force achieved new remarkable successes in combat and political training. During the past academic year there was an increase in the ranks of Military Pilots and Navigators First Class, masters of flying, who skillfully use the combat capabilities of aircraft under the most adverse conditions, at various altitudes, day and night.

Many air commanders, who are veritable masters of training and indoctrinating soldiers, during the last war had themselves passed through a stern school of combat training. The Motherland evaluated their feats of arms according to their deserts. More than 2000 aviator-pilots were honored with the high title of Hero of the Soviet Union. Many of these heroes of past combats are now skillfully training subordinates and indoctrinate able aerial fighters. In this issue of the magazine we have articles by such air commanders as Heroes of the Soviet Union P. P. Karavay, N. A. Opryshko and A. V. Sarygin as well as stories about successes in training aviators achieved by Heroes of the Soviet Union V. A. Tyshevich and M. I. Rybak. The practical experience of the heroes of past combats in indoctrinating and training subordinates in peace time presents great interest and deserves wide dissemination.

The 42nd Anniversary is marked with great successes by the aviators of the subunits headed by Military Pilots First Class, officers M. N. Molchanov and I. S. Krutenko. During the last year all the pilots here raised their class rating to the next higher level, they fly well day and night; Outstanding Men comprise three fourths of the total number of soldiers. The elements commanded by officers V. I. Maloy, B. A. Akopov and N. T. Prikhoda became Outstanding. The pilots of these subunits excellently carried out missions in tactical training and were cited by the Minister of Defense of the USSR.

The engineering and technical personnel of air units and subunits now ensure more reliably the operation and maintenance of aircraft, striving to eliminate causes for flight accidents. The soldiers of the Air Force rear are working successfully.

Due to skillful organization of work by air commanders, the initiative and creative attitude toward work of all the Party organizations and all the Communists in the units and subunits, there has been an increase not only in the number of Outstanding Airmen but also a great number of entire crews, elements, and squadrons have won the honorable right to be called Outstanding.

The aviator-fighters will also in the future strive for further improvement in showings for all types of combat and political training, increase the combat readiness of units and subunits, reliably guard the interests of our great Motherland. It is exactly here that they see their primary and paramount task. Its successful resolution will in many respects be promoted by a further improvement in the ideological work amongst the masses.

The resolution of the Central Committee of the CPSU "On the Tasks of Party Propaganda Under Modern Conditions" makes it obligatory for our army Communists and Party organizations to strengthen by all means ideological indoctrination work, strive to see that the all-conquering propaganda of Marxist-Leninist ideas attain the level of modern requirements, that it serve the victory of Communism.

Now the task of raising combat skill is set before the personnel of the Air Force in a more acute form, firstly because the Air Force becomes smaller in size and, consequently, it must be controlled immeasurably better; secondly, because it will be necessary to master new, more improved, and therefore more complex aircraft which are being adopted. The resolution of these problems is the honorable duty of the fighting airmen.

THE ORGANIZATIONAL ROLE OF COMMUNISTS MUST BE AT THE LEVEL OF PARTY REQUIREMENTS

Col. V. A. LIPATOV

With great interest and attention the aviators continue to study the decisions and materials of the December Plenum of the Central Committee of the CPSU in 1959 which summed up the work done by the Party for the steep upsurge in agriculture and outlined an extensive program for its further development.

Each commander and chief, each Party leader of the units and groups of the Air Force learns from the Party from the heroic examples of the struggle for Communism to be a militant organizer in resolving the tasks of combat training and improvement of combat readiness.

The Plenum noted with satisfaction that the period after the Twenty-First Congress of the Party was marked by new outstanding successes in the development of industry, agriculture, in the rise of the welfare of the people, in the realization of the peaceloving foreign policy of the Soviet State. As a result of the efforts of the heroic working class and all the toilers of our country, the output of industrial products in 1959 surpassed the planned quotas.

An unprecedented activity was displayed by the workers in agriculture who developed socialist competition for fulfilling the quotas of the seven-year plan in four or five years and in order to quickly catch up with the USA in the production of the most important agricultural products per capita of population. Their selfless struggle showed appreciable results. In 1959 the kolkhozes and sovkhozes produced more meat, milk, eggs, and wool than in 1958. Our country has already surpassed the USA in the gross production of milk, as well as in the production of butter per capita of population.

A remarkable example in the struggle for a rise in common animal husbandry was displayed by the workers of Ryazan' region under the leadership of the Party organization. In the past year they increased the production of meat 3.8 times and sold to the State 3 times more of it than in 1958.

Considerable results in the struggle for a rise in agriculture and animal husbandry and an increase in the output of agricultural products was obtained by the Russian Federated, the Ukrainian, the Byelorussian, and other republics, regions, districts, sovkhozes and kolkhozes of our country.

In all the republics, territories and regions, in all fields of agriculture there are thousands of innovators who show outstanding achievements. The widely-developed socialist competition shows that the decisions of the Twenty-First Congress of the Party for the development of agriculture will be fulfilled ahead of time.

In the successes of agricultural development the Soviet people see the advantages of our socialist system and great possibilities for even more accelerated development of the kolkhoz village along the road to Communism. The example of agricultural toilers, especially of the Ryazan' region, shows what great results may be obtained in resolving tasks with well set-up organizational work, correctly chosen cadres, by mastering technology, and when the masses are skilfully stirred for great deeds.

The Party organization of the Ryazan' region headed by the First Secretary of the Regional Committee, now Hero of Socialist Labor, A. N. Larionov, were able to stir and organize the masses to resolve great tasks, as a result of which the region became one of the foremost ones and a school of advanced experience.

However, slackening of organizational work is still allowed here and there. Thus in the Kazakh Republic, as a result of faults in agricultural leadership and a low level of organizational work, serious shortcomings developed in carrying out the state plans for agricultural development. In connection with this the Plenum demanded of the Party organizations that they decisively improve the condition of organizational and political work amongst the masses, achieve an increase in the output of products and the unconditional fulfillment of pledges.

The Plenum approved measures for a further rise of agriculture and animal husbandry, an increase of agricultural products and pledges for fulfilling the quotas of the seven-year plan ahead of time, and instructed the Party and the Soviet organs to concentrate the efforts of the Communists and all the workers on the practical realization of outlined plans.

Addressing the Plenum, N. S. Khrushchev said: "In the final analysis, our successes are brilliant. The enemies of socialism are now discouraged by the victories of the Soviet Union. Having these victories, we can move ahead more confidently toward new achievements. We have climbed to a great height and have gathered good speed. Therefore it is already easier now to switch over to the higher speeds and gain new heights."

The call of the Plenum to fulfill the quotas of the seven-year plan ahead of time and to create an abundance of agricultural products and the examples of innovators inspire all the Soviet people, including the soldiers of the Soviet Army, to heroic labor for the glory of our great socialist Motherland.

The decisions of the Plenum and the practical tasks ensuing from them to improve organizational work as one of the major links at the present stage are actively discussed at Army Party organizations. At past conferences and meetings, Communist aviators, armed with the decisions of the Plenum, uncovered a number of shortcomings in the organizational work of commander-Communists, political organs and Party organizations, and outlined specific measures for improving Party-political work. It is necessary that the organizational work in the units and subunits be raised to the level of Party requirements, which will serve as a pledge for resolving the tasks facing the aviators in 1960.

The improvement of organizational work amongst the masses has been always given great emphasis by our Party. The Party constantly taught and teaches that the resolutions of outlined tasks never come by themselves, spontaneously, without hard practical work, that they are secured through a high level of organizational work among Communists and non-Party men. The Party subjected those to severe criticism who substituted for live organizational work amongst the masses talks on tasks "in general", speechifying, and mere paper work.

The Party teaches that at the present stage of Communist building the role of organizational work will rise constantly, inasmuch as ever newer masses of workers join active participation in deciding national tasks, while socialist democracy attains ever greater development. Organizational work is conducive to pulling the lagging areas up to the level of the foremost ones.

In the units and subunits of the Air Force there is quite a number of remarkable organizers of combat and political training, innovators, and outstanding students by whose example all the aviators learn. Known as good organizers are air commanders A. A. Ionov, S. V. Pepelin, and political workers V. M. Yegor'yichev, N. M. Inyakin, G. Kh. Sadykov, and many others.

In the fighter subunit which is now commanded by A. A. Ionov there was previously a whole number of material shortcomings in flight training. With the assignment of officer Ionov as commander, the situation noticeably changed for the better. This Communist, an experienced air commander, supported by the force of the Party organization, introduced the necessary organization into the combat training.

Assisting the laggers and extensively utilizing the experience of the foremost pilots, masters of aerial combat and sniper fire, he was able to organize the job in such a manner that not an hour of training was wasted. The commander raised the exactingness toward subordinates, was able to create a strong nucleus of instructor-pilots. With a knowledge of the job, the Party organization actively helps the commander to eradicate shortcomings, widely propagandizes the experience of the foremost pilots and aircraft specialists. Competition became here lively and creative.

At the present time the subunit has become foremost, a fact which was noted at the Party conference, and officer Ionov was commended by the senior commander.

Soldiers are organized in a combat-like fashion for raising combat readiness and for mastering equipment and forestalling flight accidents by political workers V. M. Yegor'yichev and N. M. Inyakin. Together with the commanders, they conduct great mass-political and organizational work, striving to see that all the missions are carried out by the flight personnel in a superior manner and on time.

Since 1950 the pilots of the unit where secretary of the Party bureau is P. S. Litvinov have been flying without flight accidents. This was achieved here due to the good organizational work of commander-Communists, the great responsibility for the job entrusted, and constant feeling for the new. The commander and the Party organization managed to unite the unit into a team, to organize well the execution of each new mission, think out and conduct work to forestall flight accidents and the causes of them. As was noted at the Party conference, the Party organization does not concern itself with registering neglects, but fights for success in work and forestalling shortcomings.

Unfortunately organizational work is still far from answering the demands of the Party everywhere. As was pointed out at a Party conference, officers T. P. Levchenko and N. V. Berezin made a pledge in 1959 on behalf of the personnel of their subunit to make the subunit the best in the unit and challenged another subunit to compete. This pledge, however, was not fulfilled. Actually it was forgotten in the unit as well.

Is it really possible to call such actions organizational work, actions which are mainly directed toward registering facts? Of course not. In order to be a militant organizer of the masses it is necessary to study the state of affairs well, outline ways and methods for an upsurge in work, take into account all the resources and possibilities, stir the people for a struggle and to head it personally.

A correct attitude for fulfilling pledges made was taken in the squadron commanded by Communist L. Z. Rubin. In the past year the personnel of the squadron worked hard and persistently for fulfilling their pledges, which were embodied in actual deeds. In 1960 the squadron assumed new and higher socialist pledges: to become Outstanding and strive to see that each pilot, in addition to successfully fulfilling the plan of flight training, considerably raise his engineering and technical knowledge.

Fighting aviators carry on the service selflessly. Having warmly approved the "Law for a New Considerable Reduction in the Armed Forces of the USSR" passed by the Fourth Session of the Supreme Soviet of the USSR, the Soviet pilots, navigators, aviation specialists, and all of those who are called upon, in line of duty, to guard vigilantly the peaceful creative labor of our people, spare no efforts in raising their knowledge and combat skill to strengthen the combat readiness of the subunits.

The reduction of the Armed Forces of the USSR is a measure of great state importance. Putting the measure into practice will require considerable time, great organizational work, exceptional attention by commanders, political organs, and the Party organizations. The main point consists in the fact that this reduction must be carried out in a most organized manner, while preserving superior combat readiness in our Army and Navy. As previously, the questions of combat readiness of the troops and the vigilance of the personnel must be the center of attention for all our officer cadres and all the political and Party organizations.

The strengthening of ideological work in the masses as required by the resolution of the CC of the CPSU "On the Tasks of the Party Propaganda Under Modern Conditions" will be a pledge of the successful resolution of the tasks facing the fighting aviators.

Commanders, political organs and the Party organizations must support each new beginning, encourage the foremost men in training, and stir all the personnel to fight for new successes in their work. It is necessary to raise the organizational skills of our cadres, be an example in work, skilfully inspire the people to resolve great takss and achieve new successes. We are committed to this by the historic decisions of the Twenty-First Congress of the Party and the December Plenum of the CC of the CPSU.

This year the personnel of the Air Force have great tasks before them. In order to resolve them successfully it is necessary to raise the flight and methodological training of the leading personnel and its instructor skills to a new level. Air commanders must sharply improve the style of their work in training and

indoctrinating subordinates. By systematically adopting advanced methods of training in practice, supporting the initiative of innovators, correctly utilizing the forces of the Party and Komsomol organizations, we will achieve new successes and will indoctrinate quite a number of high-class military pilots, navigators, and aircraft specialsists. This will raise the level of combat readiness of our units and subunits.

Party conferences have shown that we have at our disposal great possibilities for a more successful resolution of tasks posed by the Party before the Armed Forces. It is only necessary that the commanders, political organs, Party organizations, and all the Communists improve political and organizational work. To be militant organizers of the masses — such is the requirement of the Party.

FOR MILITARY-HISTORICAL WORK - UNREMITTING ATTENTION

Col. Gen. of the Air Force S. I. MIRONOV,
Hero of the Soviet Union

In recent years, increasingly more military historical work is being done in the air units, commands, and educational institutions. In the Air Force of the Moscow, Carpathian, and other military districts, study of the combat operations of Soviet aviation during the Great Patriotic War has been organized. A number of subjects are being studied in the command training program. In the clubs and Officers' Homes, lectures and reports on military historical subjects are being given periodically; in the subunits, talks are being organized with the young men on the history and the combat course of the unit. Meetings with Heroes of the Soviet Union, veterans of past wars, and partisans of the Great Patriotic War enjoy great popularity among the airmen. In many air units, there are combat course stands, combat glory rooms are being built, the histories of units, commands, and educational institutions have been written and are being written.

Initiative worthy of imitation has been displayed by the motion picture fans of one of the units in the Air Force of the Moscow Military District. By their own resources they produced a documentary topical film on the history of their unit, which was given a high evaluation by the personnel and the command of the Air Force of the military district.

In the Leningrad A. F. Mozhayskiy Military Air Engineering Academy, military historical work is being conducted according to a specially worked out plan. There the study of the history of military art and the history of aviation has been organized with permanent personnel. With the aim of improving the quality of teaching this discipline, the lectures have been reworked, equipping of the history of military art and history of aviation room is being completed, textbooks and visual aids have been prepared. An authors' collective has been organized to write the history of the Academy. A history of the Academy room is also being equipped. Great service in this work has been done by the teachers of the department headed by officer R. I. Dolmatov.

To raise the ideological and scientific level of military historical work, assemblies were held of teachers of military art and history of aviation in the military educational institutions of the Air Force. This made it possible to augment

the knowledge of the teachers with important new information on the history of the Civil War and the Great Patriotic War, especially in regard to the development and combat application of the Soviet Air Force, to work out uniform views on the methodology of teaching the history of military art and the history of aviation, and to exchange experience.

In the past year, seven military historical works have been published, which can be used by the officers and generals for independent study of the combat experience of our Air Force. It must be said that this year and in subsequent years the publication of such literature will increase. Thus, a group of authors has undertaken to produce major works in which the history of domestic aviation will be reflected quite extensively and completely. Steps are being taken to publish source and reference literature. Several collections of documents on the history and combat operations of the Air Force have already been published; a work that is extremely necessary for military historians and researchers, as well as for all officers and generals, "The Soviet Air Force in the Great Patriotic War in Figures", is being produced. A series of posters on the history of our aviation is expected to come out. Work has been begun on "A History of Navigation and Aviation in Illustrations". Production of several educational documentary topical films has been planned.

All this, without a doubt, attests to an incipient upsurge in military historical work and is directed toward giving air officers and generals the necessary minimum of historical knowledge that facilitates more successful resolution of the tasks of combat training of the troops and more profound comprehension and further creative development of the present-day operational art and tactics of the Air Force. Study of the heroic past of our aviation will permit improving the indoctrination of the personnel in the glorious combat traditions of Soviet airmen.

Familiarization with the status of military historical work shows, however, that not yet all commanders and Party-political organs use to the fullest extent in the indoctrination and education of the men the glorious history of our aviation, the numerous examples of heroism and unexampled devotion of Soviet airmen to their Motherland.

In some units and educational institutions, even lectures and reports on military historical subjects are used extremely little in propaganda and cultural educational work and in the system of command training. And yet these are forms of propaganda that are accessible to all and that are most simple in organization.

Things are not entirely satisfactory with visual propaganda of the heroic past and the best traditions of air units, commands, and formations. Nothing except an indifferent attitude toward this matter can explain the lack of combat glory rooms in even some of the renowned Guards air units and commands. Still too rare is collective discussion of published military historical works, articles, and memoirs of air commanders.

Some officers and generals bury in oblivion the experience of the past war, reasoning somewhat as follows: why, they say, study the history of military art and the history of aviation when the development of technology is going forward so rapidly and therefore much of the past is no longer applicable now? Such ideas and reasoning may arise among those who seek in combat experience, in the historical past, a standard that is most appropriate for present-day combat or operations. But this is precisely what cannot be done.

Study of the history of wars, of military art, and of aviation helps to reveal regularities in armed struggle, inculcates habits of a creative approach to the development of battle tactics and the art of conducting operations that are the most applicable for the given conditions, and to a whole series of other problems that are urgent for the Air Force.

In studying history, principal attention should be concentrated on the most important operations in the Great Patriotic War. In the system of command training for the 1960 training year there can be planned, for example, a study of such subjects as the combat operations of the Soviet Air Force in the summer and fall campaign of 1941, the battles at Moscow and Stalingrad, and the air battles over the Northern Caucasus in 1943. In this, special attention should be devoted to mastering organizational experience and the conduct and support of the combat operations of Soviet aviation.

The forms and methods of study may be diverse, but lectures and seminar lessons have proven themselves in the air units and commands to be the most vital.

The time and the specific questions for each subject should be determined in addition, depending on the profile and level of the training of the study group. Let us take, for example, such a subject as "The Combat Operations of Soviet Aviation in the Battle of Moscow". In this case, a group of air unit flight personnel should analyze in greater detail the tactics of aviation operations; a group of engineering-technical personnel must dwell more on examining the work of the aircraft engineering service under combat conditions; while officers of the air technical subunits should concentrate principal attention on problems of material and technical support and airfield servicing of the combat operations of air units. In the study groups of air commands the emphasis should be on the development of tactics and particularly the operational art of the Air Force during the war.

In this it must be kept in mind that the main form of studying history will be independent work by the officers. Consequently, everything necessary must be done to make it fruitful. In particular, it is necessary to take pains that the libraries of the units and commands have the necessary quantity of military historical literature. Lists of literature must be displayed prominently in the classroom or in the rooms for independent preparation.

Both the higher and the secondary educational institutions of the Air Force should give considerable assistance to the air units in studying the history of military art, especially in the early stages. Teachers of the history of military art in the academies, the higher engineering and secondary military education institutions could go to the troops periodically to give lectures and reports on military historical subjects.

There must be no relaxation of efforts to improve and perfect the forms of teaching the course on the history of military art and the history of aviation to the cadets and students of Air Force higher educational institutions. More creativeness must be displayed in the departments in working out lectures, textbooks and visual aids.

However, not everywhere is this work being done at the proper level. Thus, in the military educational institution where the teacher is Maj. V. I. Zaytsev, the lectures are not written out completely and not all of them are apt in content.

The general military situation is outlined in too much detail in them, and too little attention is paid to the development of the operational art and tactics of the Air Force. The classroom and the history of military art room are not equipped. The diagrams are drawn very primitively, incompletely, and with distortions. Even the report cards contain violations of the requirements of methodological instructions. All this was a result of the fact that there is no proper control in the school over the quality of the lectures worked out on the history of military art and the conduct of methodological work. It is absolutely not normal when the work of the teacher in this discipline was checked only once in the course of a year and only two lectures written by him were discussed in 1958 and 1959 at methodological conferences on the series.

TO A LEADING CONSTRUCTION JOB

Near the end of last year a large group of demobilized Komsomol member airmen expressed a desire to go to the construction site of the North Siberian Metallurgical Combine.

And so the best of the best fighting men were given Komsomol passes. Those going into the reserves were accompanied to the railroad station by commanders, political workers, and Komsomol members — their colleagues in the air unit.

In the photo: Assistant chief of the political section Capt. V. I. Korneyev saying goodbye to former secretary of the Komsomol organization A. P. Noyakshev.

Photo by V. I. KOLESNIKOV.

Combat glory rooms should be set up in air commands and units that took part in battles, and history rooms in others.

A good history room has been set up, in particular, in one of the units of the Air Force of the Moscow Military District on the initiative of Communists N. Ya. Kobel'kov and V. S. Frolov with the active participation of the Party and Komsomol organizations. Shown graphically here is the glorious path traveled by the military unit and the remarkable people that were brought up in its friendly collective. It is attractively decorated, with great taste and love. The men of the unit consider it their pride and visit it with great eagerness.

There is no doubt that such rooms will help every officer and soldier to learn better the history of his unit, war deeds, and the feats of heroes from whom examples can be taken, to imitate the steadfastness, courage, and daring that have been displayed in the fight against the enemies of our Motherland.

In the Soviet Air Force there are many renowned Guards units and commands and venerable educational institutions whose heroic past and combat traditions should be known both to the men of the Soviet Army and to the entire Soviet people, especially the young generation. Worthy of approval in this connection is the initiative of a number of commanders and political organs who have already published the history of their units and educational institutions. Let us name but a few of them.

The history of the X air regiment, published by the Political Administration of the Transcaucasian Military District, shows the combat path, the heroism, and the courage of the personnel in battles at the walls of Stalingrad, in the Kursk bulge, for right-bank Ukraine, and for liberation of the peoples of Europe from the Hitlerite enslavers. A special chapter is devoted to the immortal feats of the Komsomol members of the regiment. The text is illustrated with sketches and photographs of the distinguished men of the unit.

Also well organized is the history of the Orenburg Military Aviation School for Pilots. Officers L. A. Treskunov, V. V. Veselov, F. G. Ivanov, V. V. Kondrat'yev, A. T. Klement'yev, and others worked hard on it. Related in the pages of this book is the birth of one of the oldest Soviet aviation schools, its early years of activity, the participation of the school's graduates in the development of our aviation and in battles for the Soviet Motherland, especially during the Great Patriotic War, and about those who today are multiplying the glory and traditions of the school. Reflected in it is the great concern of the Communist Party and the Soviet Government for the development and strengthening of the Soviet Air Force, for the training and indoctrination of aviation cadres.

Educated within the walls of this school were many of those who later on glorified our Motherland with heroic deeds and enriched Soviet aviation science and technology with new discoveries and achievements. In the book their deeds are shown, their recollections and photographs are given.

In compiling and writing the books, both the documents of the unit and the school and archive materials were used, as were the recollections of veterans and graduates of the school. These books have now become desk copies; they call for cherishing and augmenting glorious traditions.

In conformity with instructional documents, it is necessary to produce histories of units and educational institutions in the course of two years. The most experienced and best prepared officers should be brought in for this.

We still publish too little memoir literature and the recollections of veterans of past wars. Evidently, still inadequately developed is organizational and explanatory work among officers and generals in reserve and in retirement and the necessary conditions for their creative activity have not been established. And yet this task could successfully be performed by the political organs and Party organizations through the clubs and garrison Officers' Homes. Relying on the aktiv of officers and generals in reserve, the clubs and Officers' Homes could organize discussions of military historical works that are published and disseminate propaganda of the history of aviation more extensively.

No small role in increasing the output of military historical literature on aviation can be played by the publishing organs, and in particular, by the Military Publishing House of the Ministry of Defense of the USSR.

There is no need to prove the great importance that movies may have in the propaganda of the heroic past. Very unfortunately, almost no films appear on our screens telling of the history of Soviet aviation, of its personnel.

Air commanders, political organs, and Party and Komsomol organizations must devote considerably more attention to military historical work, which will facilitate the ideological indoctrination of the men as required by the resolution of the CC of the CPSU "On the Tasks of Party Propaganda Under Present-Day Conditions".

IN THE FOREFRONT OF THE SEVEN-YEAR PLAN

"Where are you now, regimental friends?" This question about the fate of many former fighting airmen can be answered briefly thus: in the forefront of the seven-year plan, there where the material-technical base of Communism is being built.

Here is some brief news on the peaceful work affairs of some demobilized pilots.

...The distinguished fighter pilot who destroyed several dozens of Fascist planes in aerial battles, twice Hero of the Soviet Union, officer Vasiliy Aleksandrovich Zaytsev after demobilization became head of an industrial enterprise, which, as they said in the Party district committee, "was limping on all four legs".

Former air commander V. A. Zaytsev was not frightened by the difficulties, was able to become a true production commander and bring the enterprise he headed among the leading ones. Now from month to month plans are being overfulfilled there, the amount of above-plan output is increasing, cost is declining, the technical efficiency of production is rising. The collective of the plant headed by V. A. Zaytsev is making by its labor a worthy contribution to the common cause of building Communism.

...Fighter pilot Nikolay Kuz'mich Loshakov, who fought the enemy during the war at Leningrad, worked for some time after demobilization as chief of the Vorkuta airport. However, he wanted to master the specialty of a miner and began working at a mine, extracting quality Pechora coal for the country.

Soon N. K. Loshakov became section chief in pit No. 40 of the "Vorkutaugol" Combine. The collective of this section became the initiator of competition for

high speed drift driving, for reducing cost, and for daily output of above-plan coal. In the past year alone, this section gave the Motherland more than ten trainloads of "black gold" over the plan. The renown of the outstanding miners of Loshakov's section has spread far beyond the boundaries of the Polar Region.

The labor prowess of the former pilot has been noted by a government award. In 1959, N. K. Loshakov completed a mining technical school. Now he is proposing a new frontier in his plans: without discontinuing work, to enter an institute, to attain the title of mining engineer.

...During the past war, Vasiliy Fedorovich Zagorodnyy flew a combat plane over his native localities in the Kirovograd area. He delivered accurate bomb strikes on the enemy. In the postwar period, officer Zagorodnyy mastered jet equipment and trained many young pilots. Demobilized with the rank of squadron commander, he went to his native region. His countrymen from the village of Raznosherstnoye in Ul'yanovskiy district informed him of their affairs, of what was preventing them from bringing the kolkhoz out from among the most backward ones in the area.

"We have no head, no master," his countrymen said to him and immediately asked him: "Perhaps if you, Vasiliy Fedorovich, would take over the job... You know machinery; you know how to work with people."

And Zagorodnyy made the decision. The Party district committee recommended him for chairman of the kolkhoz, and his countrymen approved this recommendation unanimously.

The former squadron commander, and now chairman of the M. I. Kalinin Kolkhoz, has done much to bring the establishment up. First of all he took a number of organizational measures. The brigades and teams were enlarged, and the administrative apparatus was reduced. Things began to go better. The kolkhoz members built an electric power station, a mill, a creamery, and applied electrical machinery. The number of cattle increased, crop yields were higher, the incomes of the kolkhoz members rose. The annual income of the kolkhoz is now 8 million rubles. The kolkhoz members are confident that they will fulfill their plans for the septennium in four years. Inspired by the historic decisions of the December Plenum of the CC of the CPSU, they are achieving new successes in their work.

During these years, former pilot V. F. Zagorodnyy has become intimate with the affairs of the kolkhoz; he has learned many secrets of crop cultivation, animal husbandry, and other branches of agriculture, and this year he is completing the correspondence division of an agricultural institute.

Such are the new professions of former pilots who have gone out into the national economy, to the forefront of the seven-year plan. Having said farewell to the control sticks of combat craft, they have firmly established their place in life and are working honorably for the happiness and flowering of their beloved Fatherland. And their battle comrades who have remained in the service are continuing to work just as stubbornly and persistently to increase the combat capability of the air subunits, performing their military duty with honor.

HEROES OF THE SOVIET UNION — MASTERS OF TRAINING

The Gold Star of a Hero of the Soviet Union carries many obligations. Today's young airmen compare themselves to the heroes of past battles; they have faith in them, they try to imitate them. And the great majority of the air commander heroes justify with honor their high title. In this issue we are publishing the opinions expressed by air commanders who have been awarded the high title of Hero of the Soviet Union — P. P. Karavay, N. A. Opryshko, and A. V. Sarygin — and we also are featuring articles telling about how heroes of battles are training subordinates in all-weather flying and in the tactics of waging battle.

CONFIDENCE — A FACTOR IN VICTORY

Col. P. P. KARAVAY,
Hero of the Soviet Union

In describing the moral-political and combat qualities of this or that pilot, it is often said: "He flies confidently." During the past war a similar expression appeared as follows: "He flies well and wages battle confidently."

Confidence — what a comprehensive and significant word this is in defining the qualities of a pilot! After all, in studying the qualities of the pilots subordinate to him, any air commander strives almost as the first thing to find out how much the trainee believes in himself and in the equipment that is entrusted to him. And if in a flight an instructor detects in the actions of the trainee or the one being checked nervousness, lack of confidence, or indecisiveness, he immediately comes to the conclusion that the pilot is poorly trained and inadequately indoctrinated.

We are speaking of a pilot, having in mind a staunch aerial fighter who is convinced of the greatness of the honorable mission that has fallen to the lot of the Soviet fighting man, protecting the peaceful creative labor of his people — the builders of a Communist society; a fighter who is ready at any moment to act in defense of his Fatherland and to wage battle skillfully and courageously, in such a way as to achieve victory under any conditions. The task of an air commander consists precisely in teaching and indoctrinating his subordinates in the spirit of these requirements, in the spirit of the military oath.

In our everyday training and indoctrination practice, we, the air commanders, strive to instill in the trainees the high moral-political and combat qualities that determine the profile of a fighting man of the Soviet Army. An honorable place in this multifaceted work is occupied by indoctrination of a sense of confidence in the justice of one's cause, in one's own abilities, and in one's weapons. Confidence in the justice of the great historical mission of the fighting man of the Soviet Army is instilled in every citizen soldier by the entire tenor of life in our Soviet state.

The air commanders of our school have favorable conditions for ideological indoctrination work with subordinates. First of all we would like to note that noteworthy traditions have developed in the school; it has a rich history, the bright facts of which form abundant material for indoctrination.

As a matter of fact, the Kachinsk Aviation School is the oldest in our country. This year it will be 50 years old. Thousands of excellent pilots have been educated within its walls. Many of them have glorified our aviation by their heroism, courage, ability, and faithful service to the great cause of our glorious Communist Party. It is enough to say that 225 graduates of the Kachinsk school have been awarded the high title of Hero of the Soviet Union, ten men were twice awarded the "Gold Star" medal, and one — Aleksándr Ivanovich Pokryshkin — became three times a Hero of the Soviet Union. And how many pilots who had completed our school have been decorated with orders and medals for combat feats and faithful service to the Motherland!

These are facts. Behind each of them stands a Soviet man, his character, his life, and his deed. And in telling the cadets now about the heroic deeds of graduates of the school, we strive to show them the most important thing — that which was guiding the men, directing all their feelings, their thoughts, and their actions both in peaceful times and during the most difficult minutes of battle. This most important thing consists of a high ideological conviction, a deep faith in the justice and triumph of our cause.

Our commanders, teachers, political workers, and Party and Komsomol organizations always take pains to instill and perfect in the soldiers, cadets, and officers such qualities as political consciousness, devotion to our Soviet Motherland, the Communist Party, and the Soviet people, and readiness for selfless defense of the cause of Communism. For this purpose, we use first of all such forms as Marxist-Leninist training of the officers, study of the history of the Communist Party by the cadets, political lessons with soldiers and sergeants. We also hold talks, political information sessions, meetings of the men with the leading people of enterprises, construction jobs, and kolkhozes; theaters are visited; excursions to battle sites are organized; etc.

A great influence on the growth of the political consciousness of the men is exerted by patronage ties and meetings with the collectives of plants and kolkhozes. Not long ago there was held in one of the subunits a youth evening of cadets and plant workers. The brigadiers of Communist labor brigades addressed it, telling about how they work, live, and study.

Ideological conviction in the justice of one's cause is indivisible from a man's faith in his own abilities in his weapons. These qualities are organically merged into one, and the air commander will achieve success only when he begins to develop them in complex, in interrelationship. The success of a pilot's entire flying

experience depends on how confident he is of his own abilities, knowledge, and skills, on how much he "trusts" his plane with its multifarious instruments.

To instill these qualities is not an easy matter. It requires of the commander first of all a strictly individual approach, a profound knowledge of the strong and weak points of the trainees, considerable flying experience, and outstanding knowledge of the equipment.

There still are among us, unfortunately, commanders and instructors who underestimate individual work and do not try to get closer to their subordinates. They usually express the danger that such relationship may undermine their authority, may weaken exactingness.

It is not difficult to prove the erroneousness of such views. Last summer, in the subunit commanded by I. A. Shchenov, cadet A. D. Kolkov permitted a slight drift in landing, then did not manage to correct it, and dumped the plane on its wing. A check showed that in the subunit, preparing to let the cadets fly solo, they had displayed haste, had not studied each cadet and his flight training in detail, and had decided to permit nearly all of them to solo.

Hero of the Soviet Union Col. P. P. Karavay.

After the breakdown Officer Shchenov went to the other extreme: as soon as one of the cadets repeated some mistake, particularly during a landing, he immediately suggested washing him out of the school, attempting at the same time to prove that, supposedly, the cadet is not capable of becoming a pilot, since he does not possess the necessary aptitude.

Such treatment traumatized the cadets psychologically. The command and the party organization were compelled to interpret these facts. And what was discovered?

Here is one example. Cadet Yu. A. Filin's flying became unsteady; he sometimes made serious errors. The suggestion was made to wash him out. We had a talk with him. It developed that Filin came to the flying school with a lot of enthusiasm; he studied with perseverance and persistently, but in some areas he had difficulty; moreover, for some time he was ill and fell behind in his studies.

"I want to fly," Filin announced, "but not everything runs smoothly. I am trying to correct my deficiencies."

The last words the cadet uttered without conviction. It was evident that he was beginning to seriously doubt his own ability and aptitude.

I understood his state of mind. After all, I too at one time had been a trainee, and I too had a similar difficulty. I was discouraged by failures, faith in myself and my abilities waned, and with it fled the hope of becoming a pilot. It was then that my instructor came to my aid! His firm conviction in my ability to surmount my difficulties was unwavering. It seemed that he knew what I was capable of better than I did. Patiently the instructor over and over again showed me how to perform the troublesome operation until he finally succeeded.

"You will fly," he firmly announced after a routine flight during which I had achieved some measure of success in fathoming the "secret" of performing a difficult aerobatic maneuver.

From flight to flight my skill improved and with it grew faith in myself and the remarkable Soviet craft. And this faith, springing forth and growing strong through the painstaking care of the instructor, withstood all the trials of war years spent in combat. Many times my fighter-pilot subordinates and I were faced with a difficult combat situation. And every time we came through the difficult trials with honor. In 170 combat sorties made with my combat comrades, I carried out 31 aerial battles, personally shooting down 16 enemy aircraft and took part in 7 group battles. The feeling of confidence in my own ability, in my aircraft and armament was the firm basis of the victories I won.

This is what I recalled when I was having my talk with cadet Filin. It was necessary to help him to gain confidence in himself, in his ability. We managed to support the cadet in this moment so difficult for him, to force him to believe that he could fly successfully. Soon I had occasion to fly with him on a training plane into the practice zone. Under difficult circumstances Filin made the takeoff, the flight in the pattern, and the landing successfully. True, Filin did not know the documents that regulate flight work as he should have. But he quickly corrected this. I think that Filin will be a good pilot.

To undermine a trainee's faith in his own ability is easy, to restore and strengthen it is many times more difficult. We know that the activity of a pilot takes place under peculiar conditions, and the flying profession itself requires certain definite qualities.

What qualities are required for mastering the piloting technique and the combat employment of a present-day aircraft? In our opinion a pilot must be quite capable of concentrating his attention and reacting quickly, he must not be "stiff" and overly tense in flight, he must have good health and a good physical constitution, as well as good theoretical training and outstanding skills in operating aircraft and the special equipment.

As we can see, these qualities cannot be inborn. This means that the flying profession does not demand of a person any special "natural" endowments. A genuine combat pilot can be developed during the process of training out of any youth who has a normal level of physical and mental development.

Yet at one time there was among pilots a so-called theory of "inborn flying qualities", according to which a pilot must be born and only some kind of special innate qualities of "flying talent" are a pledge of successful flight work.

From this there also flowed an underestimation of the role of training and teaching of the business of flying. Instead of doing painstaking work with this or that cadet, they often cast him aside as incapable. The methodology of teaching the technique of piloting, which consisted of narration, explanation, and demonstration both on the ground and in flight, was underestimated. This same "theory" of innate flying qualities engendered among the trainees a lack of faith in their own abilities at the very first failure or difficulty.

Many years of experience in teaching and training cadets in the business of flying at our school eloquently refutes this, if one may call it that, theory. Experience attests to the fact that those instructor pilots and teachers who study profoundly the qualities of the cadets from the first to the last days of their training and who use the individual approach in teaching achieve positive results.

A good example is the activity of instructor pilots officers P. G. Gribkov, Yu. Yu. Ryazanov, Yu. K. Skirmunt, B. L. Podosinnikov, S. G. Savinov, and a number of others. Training subordinates in complex aviation equipment for a long time, they have achieved high results, and they have not washed out a single cadet because of lack of flying proficiency.

What is the answer? Why do these instructor pilots have no unproficient students? Have they had only cadets with high "innate" flying qualities? Their success lies in the fact that they know very well the basic principles of Soviet pedagogy, apply them efficiently in the process of training, and understand to perfection the technique of piloting a plane and the methodology of demonstration both on the ground and in flight. They do not look for inherent qualities among the cadets, but during the entire course of the training period they inculcate in them the necessary qualities, instill a valuable sense of confidence in their abilities and in the combat equipment.

Even in these subunits there are difficulties, critical situations so to speak, but the teacher commanders help the cadets in time to overcome their difficulties.

Let us give an example. Cadet V. A. Fedorov successfully completed the dual program in a combat training plane and received permission to make a solo flight. But he made the first solo flight and subsequent flights with grave mistakes. What was the matter?

Calling up the trainee for a frank talk, instructor pilot officer S. G. Savinov found out that he had lost faith in his ability because the crackup of a plane by another cadet had made a negative impression on him.

The instructor had to work to instill the necessary moral qualities in the trainee. Once again they had a talk about the reliability of the aviation equipment. Flights were made to correct mistakes in landing. During the landings Savinov created situations such that the plane deviated from the assigned glide path, brought the craft down to the ground with a low or a high roundout, etc., and required the cadet to correct the mistake. With each flight the trainee acted more confidently and competently. He learned that the plane is very reliable, it is only necessary to operate it competently and skillfully. As a result, Cadet Fedorov

began to execute flight missions successfully and completed the training course entirely. We have many such examples of a sensitive attitude toward the trainees on the part of the instructors.

The great majority of our commanders understand how great is the significance of the moral factor in raising the combat readiness of the troops. That is why they work constantly to inculcate high moral-political and combat qualities in the pilots, instill in their hearts confidence in the justice of the great cause of protecting their native Fatherland, in their own ability, and in remarkable aviation equipment.

The cadets at the Kachinsk school know Col. P. P. Karavay well. Evenings and in his free time he often visits them in the barracks, and he encounters them at the airfield. And every time he has something to talk about with the cadets.

In the photo: Col. P. P. Karavay among young cadets.

Photo by V. P. SCHASTLIVTSEV.

Confidence is an excellent quality, but it has nothing in common with excessive and unfounded self-assurance that borders on conceit. Only persistent work, tremendous exertion of effort and capability in mastering the equipment lie at the basis of the remarkable quality of which we are speaking. Only he who knows his business thoroughly, who has become a master, can have confidence in himself and in his plane. And the paths to mastery are open to every fighting man.

EVEN A STRONG ENEMY HAS WEAKNESSES

Guards Lt. Col. N. A. OPRYSHKO,
Hero of the Soviet Union,
Military Pilot First Class

A command — and the planes taxi out on the runway one after another.

An element of bombers was to deliver a bomb strike against an objective that had a strong PVO [AA defense] system and was located far behind the front line.

After takeoff, having gained altitude, the planes took the assigned course. At the tentative "enemy" fighter vectoring line, the bombers began an anti-fighter

maneuver. At that moment the lead pilot reported that "enemy" fighters were approaching from the left and above. Having established the type of planes and taking into consideration their armament, the element commander ordered the pilots to close in and prepare to repulse the attack. The fighters approached in a rush. They separated into pairs and attacked the bombers simultaneously from different sides.

The battle lasted for several minutes. After the attack the fighters turned aside and disappeared from view.

The element of bombers continued its flight. In approaching the target, the planes executed an antiaircraft maneuver and, coming out on the target, dropped their bombs.

"Mission accomplished," reported the element commander. He was not playing the hypocrite but really believed that the mission had been accomplished successfully: the attacks of the fighters had been repulsed and the bombs had been laid exactly on the target.

But let us imagine that this was not a training but a combat sortie. What does it mean for an element of bombers to engage in aerial combat with two pairs of fighters prior to coming out on the target under real combat conditions? Can it be said with assurance that the mission assigned the element would have been accomplished?

I think not. Another question arises: Why was the "enemy" able to spot the bombers and direct his fighters to them? And was it not necessary to avoid this? Of course, under combat conditions fighter attacks are a natural thing. But we are discussing a particular case. And if we analyze the flight, it becomes clear that there need have been no encounter with fighters.

Where then was the element commander's mistake? First of all in that he selected the route and profile of the flight without taking into consideration the actions of the "enemy" and the capabilities of his spotting and vectoring facilities. The element delivered its bombs well; the attacks of the fighters were repulsed correctly. Yet how effective the bombers' tactical move was — this the element commander did not consider.

Unfortunately, such underestimation of the significance of tactical factors is also observed among other pilots, especially young ones. In conversations with them one can often hear such expressions as, since the equipment, they say, has now become so improved that it is practically impossible to fly unnoticed, there is no need to think about this.

Even commanders are still found who, for the sake of good indexes, try not to notice tactical errors committed by pilots during a flight and who resort to simplification.

A major mistake, in our opinion, is underestimation of the experience of the Great Patriotic War. It goes without saying that much has changed now — aircraft flight speeds have increased, equipping of them with various technical facilities is greater, ground equipment has improved. All this, of course, requires changing tactical methods.

After all, the experience of the Great Patriotic War is not studied to obtain ready-made standards from it mechanically. Improvements in aviation equipment necessitate searching for new tactical methods that are more effective under present-day conditions. Combat experience shows that a pledge of the victory of

Officers N. A. Opryshko and V. S. Molkov working out a tactical situation.

Photo by V. A. Zheleznikov.

our pilots was their moral supremacy over the enemy and their high degree of tactical knowledge. However strong the enemy might be, he always has weak aspects which it is necessary to know and use skillfully in combat.

The following episode comes to mind.

It was the spring of 1944. The Germans were retreating all along the front. At that time I was flying an Il-2 attack bomber and took part in battles on the Yassy-Kishinev sector.

Retreating under the blows of our troops, the enemy had great difficulty with airfields for his air forces. It was found out that many aircraft had congregated at an airfield located 80-90 km from the front line, in the city of Khushi. Around it there was a whole network of jumping-off airfields and landing strips. On them fighters were on the alert around the clock. It seemed that there was no possibility of flying up to the airfield unnoticed, and even less of carrying out a mission without losses. For this reason some people thought that there could be no thought of secrecy — it was necessary to fly in straight and deliver the strike. And losses, it was said, were inevitable. This was war!

The commander of our command decided otherwise. He thought out everything in detail. Takeoff was set for dawn. The route to the target had three breaks and was selected in such a way as to cross the front line at a sector where the foe was least active. Further on, the flight was planned to go over a scarcely populated area 25-40 km to one side of the enemy fighters' jumping-off airfields and landing strips. The last leg of the route went over some hills where there were no enemy fighters. The route from the target to the landing airfield also had two breaks.

The flight altitude to the target on each leg of the route was established at 300-500 m, and only on the last leg were the planes to climb to the altitude assigned for the attack. It was proposed that after the attack all the planes would go to their home airfield at treetop level, taking advantage of folds in the terrain.

They flew precisely by the plan worked out. Below the planes, the grey tops of the hills could be seen in the predawn fog. There was not a single light anywhere. On the last leg of the route, before the approach to the target, the planes began to climb. Then the small city of Khushi was seen, and the watchful eyes of the pilots distinguished the airfield.

The commander's voice could be heard in the earphones: "To the attack!"

Turning, the attack bombers dove headlong, pouring fire on the enemy planes. Bomb bursts covered the parking areas. The airfield was transformed into a bonfire. Maneuvering at treetop level between folds in the terrain, the planes flew away from the target. When the enemy fighters took off, the attack bombers were already behind the front line. Even the antiaircraft artillery did not manage to open fire. Thus the commander's clever tactical idea and the pilots' skill in effectuating it made it possible to carry out a difficult combat mission with maximum effect, by surprise, and without losses. Such experience will always be useful for training and indoctrinating the flight personnel.

Even now there are many examples attesting to the fact that tactical skill gives the possibility of successfully carrying out a training mission under the most difficult conditions. Indicative in this respect is the flight of an element commanded by Military Pilot First Class Capt. A. G. Novosel'tsev.

In an exercise the element was given the task of delivering a bomb strike against "enemy" transport located in port. Studying the tactical situation, Novosel'tsev understood that the mission was very critical: the bomb strike had to be made from a high altitude, and this made the mission considerably more difficult, inasmuch as according to the tactical development the "enemy" had a strong and well organized PVO system.

What then was the way out?

During the preparation for the flight, the officers computed the spotting lines for different altitudes and evaluated the "enemy" fighters' possibilities of intercepting the bombers. In conformity with this, they determined on what legs it was best to execute a maneuver, at what speed and what altitude to fly in order to avoid being "hit" by AA fire.

They paid considerable attention to laying out the route. After all this is one of the difficult elements of a flight, on the proper selection of which depended the accomplishment of the mission. To lay it out where the "enemy" did not expect our bombers to appear, to confuse the fighter interceptors by a false flight direction, to compel them to fly away from the element's flight direction — this is the task that Novosel'tsev set himself.

After taking off and gaining the required altitude, the crews followed precisely the proposed route to the spotting line. Then they executed an anti-fighter maneuver.

On the third leg of the route, aerial radio gunner Pfc. V. N. Polatin reported to the crew commander, Pilot Second Class V. I. Kolosov, that to the right he could see the contrails of a pair of fighters, which were going perpendicular to the

direction of flight of our bombers and 2000-2500 m higher. Kolosov immediately reported this to the element commander. Novosel'tsev ordered:

"Act according to the situation; make decisions independently."

Novosel'tsev was confident that Kolosov would be able to handle this task. And Kolosov did not let him down. He decided to decoy the enemy fighters "to himself" and turned the plane to the left by 30° from the assigned course with a climb. The fighters fell behind, but the radio gunner attentively followed their movement by the contrail.

At the same time the other crews turned sharply to the right by 25° from the assigned course with a climb.

Soon the radio gunner reported that the fighters' contrail had disappeared. Kolosov decided that the fighters had seen his plane and had begun to descend. This meant that the maneuver was successful. The fighters were aiming for him. He could engage them in battle, by which he would ensure the accomplishment of the mission by the other crews, primarily by the element commander.

Kolosov's crew executed several vigorous turns in direction with a simultaneous change in altitude. Navigator Senior Lt. V. P. Matyunin watched all the time that the general direction of the flight conform to that assigned.

Soon Kolosov heard Novosel'tsev, and after him the second crew commander, Military Pilot Second Class Senior Lt. V. K. Voronenko, report to the KP [command post] by a conventional signal to the effect that the mission was accomplished.

The main thing had been done — the target had been hit. Kolosov turned the craft and directed it along the route specified in the flight plan.

Suddenly the radio gunner again reported to Kolosov that a pair of fighters had appeared to the right and above. Kolosov immediately turned the plane by 25-30° to the right with maximum descent. The fighters could not be seen. He asked the gunner their position. The latter replied that they had passed by at a high altitude and disappeared from view. "The maneuver helped," thought Kolosov, and again brought the craft out on the assigned course, continuing the descent.

After the planes landed it was found out that the bombing had been performed outstandingly.

Gratitude was expressed to the personnel of the element for exemplary execution of the mission.

What was the basis of the success of Capt. Novosel'tsev's element? Was it, perhaps, a matter of chance? Let us try to analyze his actions.

Knowing that the "enemy" has interceptor fighters, the element commander selected the route and profile of the flight correctly, and set up the element's combat formation tactically competently, thereby preventing the "enemy" from attacking all the planes at once and giving each crew freedom of maneuver.

By deciding to decoy the fighters "to himself", Senior Lt. Kolosov helped the other crews to accomplish the mission. Then maneuvering skillfully, he managed to escape the interceptors himself.

The success of Novosel'tsev's element was not happenstance but the result of detailed study of the tactical situation by the personnel, determination of the most vulnerable points of the "enemy", knowledge of the basic tactical moves, which helped to utilize the "enemy's" weakness to their own advantage.

This sortie showed once again that no matter how strong the enemy, no matter how well organized are his defense, his system of control, vectoring, and interception, nevertheless it is possible to find his vulnerable points, which should be taken into account in choosing the decision. For this it is necessary to know to perfection the combat capabilities of the enemy and to act creatively and with initiative in every flight.

THE FIRST FLIGHT IN A NEW PLANE

Col. A. V. SARYGIN,
Hero of the Soviet Union,
Honored Test Pilot of the USSR

This was during the Great Patriotic War. We were flying SB* planes. Then a rumor reached us that we would soon receive new craft designed by Petlyakov — Pe-2's. We had dreamed about this for a long time. Everyone wanted to sit down behind the control wheel of the new and improved bomber.

As soon as the planes arrived at the unit, we immediately began to study them. The front required that we be brought into combat work as rapidly as possible, and therefore a minimum of time was allotted to preparation for flying. In two or three days all our pilots mastered the piloting of the new craft.

It is easy to say "in two or three days." But that is what the situation required. It was necessary to take a risk, to fly without preliminary dual flights. This was necessary, at a difficult time for our Motherland, in order to defeat the enemy as quickly as possible.

In the postwar period, as during the war, the flight personnel are from time to time confronted with the task of mastering new planes. This task is performed by both the cadets at flying schools, and the pilots of line units, and us — the test pilots. After all, equipment is developing continually: first subsonic and then supersonic jet planes came to replace piston planes. The pilot had to master every one of these planes to perfection.

And so, how is it best to conduct this work under present-day, more favorable conditions? It is evident that the risky course which it was sometimes necessary to take during the war years because of lack of time is unacceptable today. But nevertheless, war experience also contains much that is useful. It teaches to save time, to find the most important thing in the system of training and to concentrate the principal attention on this. Finally, it helps to mobilize people better to perform the fairly difficult task which the first flights in a new type of plane are.

Every such flight, undoubtedly, must be preceded by thorough ground training. For pilots of line units, it is expressed in the study of new technology, of the appropriate instructions and manuals. We, the test pilots, do not have prepared instructions, because they do not yet exist in nature. We must ourselves discover the "secrets" of the new machine and work out a methodology for handling the plane, which then becomes a manual for the flight personnel.

However, I would like to note that not a single manual, even the very best, is in position to encompass everything that a pilot may encounter in his first flight in a new plane. Therefore, even before the flight he must comprehensively think

* [medium bomber]

through how he will act in this or that situation. I would call this the moral training of a pilot. It is of very great importance.

After all, just what is the first flight? It is an encounter with the unknown. The test pilot can only suppose how the machine will behave, while the pilot of a line unit will already have adequate information about this. However, nothing is able to communicate the sensations that the pilot experiences in piloting a plane new to him. Everything makes an impression on the pilot: the still unfamiliar speed of flight, and the somehow different engine noise, and the unfamiliar view from the cockpit or an unfamiliar ease of handling, and much else. All this is summarized in the pilot's consciousness, and he gradually becomes accustomed to it in other flights, but in the first one the strongest feeling is the fact that he is coping with the plane.

What to do then so that this feeling would come as quickly as possible and would become firmly established in the pilot in subsequent flights? This is given primarily by experience. The more experienced the pilot, the more quickly he adapts himself to a new plane. But another thing is also important here: how to prepare oneself to sit down boldly behind the control wheel of a new machine. I do not know how it is with others, but for myself personally there comes a time in the process of studying a plane when I can say firmly to myself: I am ready to fly. What makes it possible to come to such a conclusion is the sum of the knowledge acquired about the plane and the observations of the takeoffs and landings of comrades who are flying a similar machine. Their stories about a flight just completed are very useful. In watching the flight of a new plane, I always try to answer a whole series of questions: how does the plane break away from the ground, what is the nature of its flight after takeoff and in landing? All this taken together helps to undertake confidently the piloting of a new plane and to make the proper decision in an unexpectedly developing situation.

Once pilot F. F. Opadchiy and I were testing a jet bomber. This was one of the first test flights. We had already begun to get accustomed to the peculiarities of the new plane, when suddenly a heavy blow in its tail section caused us to shudder. The machine immediately began to shake as though in a fever. Although it retained controllability, it was very difficult to fly it. More assuming than knowing the cause of what had happened, Opadchiy and I started to select the flight speed at which the shaking would be the least, and at this speed we went in for a landing. The heavy bomber touched down safely, and when we began looking for the trouble we saw the cause of what had occurred. A proper evaluation of the situation that had developed and precise actions helped us to complete successfully this difficult test flight.

Of course, for the pilot of a line unit the probability of getting into such unexpected conditions is immeasurably smaller. However, something similar may happen to him also. In order to eliminate the unforeseen, it is necessary to study the instructions very attentively, to think through every one of the propositions in them, and to imagine in one's mind the entire flight from takeoff to landing. Special attention should be devoted to the elements that are to be practiced in the first flight.

It is very important to study comprehensively the aerodynamic characteristics of the plane: how the machine will behave at low and high speeds, in gliding and in climbing, in turns, etc. Now, in the period of supersonic speeds, this is

Col. A. V. Sarygin.

especially necessary, because in aerodynamic characteristics every new plane differs drastically from its predecessor.

One of the principal conditions of a successful flight in a new plane is also a thorough study of the cockpit and all the equipment.

In the postwar period, I have had to retrain many pilots on new planes. I had the opportunity to observe how they go through this exciting moment. Some approach it, as they say, in full combat readiness. You look at such a pilot and there is not the slightest doubt that he will fly successfully. You check him — both his knowledge is good and he himself is completely mobilized. Another officer will suffer very strongly in his first flight in a new plane. Such a pilot must be examined attentively. Perhaps this is his usual condition before a critical flight? But it is possible that he is simply not ready for it. Then one should not hurry; it is necessary to repeat again and again everything that is associated with the preparation for the first flight in a new plane.

I think that those air commanders are right who in retraining a pilot on new equipment put him in his first flights in a crew that has already flown a plane of

that type. The experienced comrades can give valuable advice. But here the individual characteristics of the trainee should be taken into consideration, and in each specific case a strictly individual approach should be made in designating the crew that is to train on a new plane.

Most often the entire crew trains together with the pilot. There is hardly any need to give any special advice to each member of the crew. But one requirement must be satisfied unconditionally: both the pilot and the navigator, and the aerial radio gunner, and the flight engineer — they must all master their duties firmly and perform them strictly in flight. Inasmuch as on a new plane new duties may appear for this or that member of the crew, they should be studied thoroughly. After all, as a rule, behind these duties there often lie the most vital peculiarities of the crew's work in the air, those on which successful performance of the flight depends.

As has already been noted, in the first flight in a new plane everything is new to the pilot. First he felt how the machine behaves in the takeoff run and in breaking away from the ground. Then he became convinced of its ease of handling in level flight. And then he is confronted with the first approach and landing. I am absolutely convinced of the fact that as a pilot accumulates experience in flying different types of planes he also acquires practice in making a precise landing approach. Such a pilot will always be able to select the most suitable gliding angle and speed for any plane.

We, the test pilots, write instructions for all pilots. It is necessary to instill in the flight personnel a most serious attitude toward these documents, which are written on the basis of considerable experience of our best comrades.

If a pilot studies the instructions thoroughly and attentively listens to the advice of more experienced comrades, the first flight will surely go off without any difficulties whatsoever. But the most difficult thing usually begins in subsequent flights when the elements of piloting become more complicated and they go over to the combat application of the plane. The first step, i.e., the first flight, is relatively not difficult to perform, but later skill and persistence are necessary in order to achieve success.

Sometimes one is simply amazed. You watch a pilot's first solo flight in a new type of plane and you are overjoyed: everything is done as well as can be — both the takeoff and the landing merit the very highest evaluation. The pilot goes up the second and third time, and the flight also proceeds normally. But in subsequent flights something happens that he himself cannot explain why it occurred.

However, all this can be explained simply. In the first flights the pilot's attention was mobilized. He did not permit the slightest deviation from the requirements of the instructions and the directions he received from the instructor before the flight. After all, this is the first flight! But then the pilot felt that the machine is good, that it handles easily, and he relaxed his attention. And his piloting skills are still not strong, he has not learned something adequately, he has neglected something, and as a result he put himself on the brink of a flight accident. So that this does not occur, every instructor commander must not reduce his exactingness toward the trainee in a single stage of the training.

A HERO TEACHES FLYING UNDER ADVERSE WEATHER CONDITIONS

Col. G. G. SEMENKO,
Military Pilot First Class

I met Hero of the Soviet Union officer V. A. Tyshevich on a day of commander training. All the flight personnel had gathered in the classroom. Various diagrams and charts were hung on the walls. On the table were models of planes.

Tyshevich began the lesson with an analysis of the climatic and meteorological characteristics of the base area. Using many years of weather data, he discussed the nature of it by months, pointed out the number of cloudy days (nights) with the base of the clouds and the visibility corresponding to the established weather minimum for the given airfield, the number of days and nights when the base of the clouds was above 1000 m. For vividness all these data were reduced to a general chart by years.

Tyshevich has paid such attention to meteorology ever since his war years. The ability to evaluate weather conditions helped the pilot more than once to gain victory in battles with the enemy.

Once the squadron in which he was serving was given the assignment of dive bombing an enemy column. But how was this to be done, since for several days a heavy multi-layer overcast had hung over the entire area of combat operations? In places the clouds went right down to the ground and became fog, completely depriving the pilots of an opportunity to fly a mission.

At that time there were still no radar sights on the planes, and also many difficulties were encountered in meteorological support of flights. In the little known area, no one could foretell with confidence how the weather would change in the near future over the territory occupied by the enemy, who, naturally, kept all such information a close secret. And yet our pilots were able to find a way out.

Analyzing the information on the weather together with the meteorological specialists, utilizing the tales of old residents in regard to the climatic characteristics of the region, Tyshevich and the other pilots came to the firm conviction that the fog over the target designated in the assignment would dissipate during the time of the flight and the base of the clouds would rise high enough that an opportunity to carry out the mission would develop.

The takeoff was made exactly at the appointed time. One after another the attack planes rose into the air. The enemy's airfields were covered with fog, while in the area of the target the long-awaited clearing developed, confirming the calculations that had been made. The target could be seen well from the very edge of the clouds. The enemy did not expect such a daring raid and was not prepared for defense, and this showed up immediately in the results of the assault, after which many smashed vehicles and dead Fascists were left in the field.

During the war Tyshevich always studied very attentively the climatic characteristics of the area of combat operations.

Tyshevich retained this strict attitude toward aviation meteorology for his entire life. And when the unit went into the matter of mastering flying under adverse conditions, he demanded of the pilots that they learn aviation meteorology even better. And now this has a positive effect on combat training.

And even now Tyshevich conducts lessons on meteorology. He believes that it is precisely an analysis of weather conditions for past years that will make it possible to determine with sufficient accuracy the number of flying days for the forthcoming training year and to conduct flight training uniformly without prolonged interruptions in the flying, primarily under adverse weather conditions.

Further, officer Tyshevich set forth in detail the methodology of planning and preparing the flight personnel for the first and second class rating; he spoke of the number of flights and the flying time for confirming the class ratings of the pilots.

First of all he dwelt on the mistakes of the past training year, when the training periods for the rated pilots were extended over a long period. The flight personnel who were preparing to pass examinations for second and first class were training without a plan and without consideration of the actual weather conditions and the periods of training. By virtue of this, some pilots who had the actual flying time under adverse weather conditions corresponding to the level of first class were unable to obtain the higher rating during the year because of the fact that they lacked a few, and sometimes only one or two, landings at the established weather minimum.

Analyzing the shortcomings in confirming the award of ratings to the flight personnel, Tyshevich proved by convincing examples that the sources of these shortcomings lie primarily in the plan of flight training. In drawing up the plans of flying time for confirming the ratings, some commanders propose exercises not for combat application and not for tactical flight training under adverse weather conditions but the most simple exercises that had been practiced by the pilots long ago, principally exercises in the technique of piloting by the system. As a consequence of this a large amount of the pilots' flying time is used not for combat application but for perfecting the elements of piloting technique.

Tyshevich gave the supervisory officers methodological recommendations on training pilots for the second and first class ratings that had been proven in the practice of teaching. He noted that all the pilots should not be trained simultaneously, but it is necessary to assign a certain group, taking into account the actual possibilities, to plan the training of this group efficiently and to conduct this training strictly according to the plan, making maximum use of adverse weather conditions.

In order that a pilot could make the necessary number of landings at the weather minimum, it is necessary to draw up a plan schedule for the entire training period. In this, the preliminary preparation for flights will be conducted only once, while just before the flight it will be necessary only to definitize the procedure of carrying it out. In the training for class rating it is also advisable to hold special assemblies during that time of year when adverse weather conditions predominate.

On this day officer Tyshevich held yet another lesson with the crew of the landing system. For our airfield, he said, the most adverse weather conditions come up, and therefore in order to ensure flight safety completely it is necessary to know well the service equipment and its capabilities and one's actions when the flight personnel are carrying out various missions under adverse weather conditions.

In conducting such lessons, officer Tyshevich daily instills in his subordinates a high sense of responsibility for the work being done. And in order that his recommendations would be more convincing, he shows by examples what incorrect actions in supporting flights lead to.

Col. V. A. Tyshevich

Ubiquitous — that is what the pilots say about their commander in jest. Not infrequently he directs the flying himself and he teaches the commanders this skill. Very often before the next more complicated exercise is practiced he can be seen in a combat training plane, where he checks the methodological skills of the commanders who are teaching the pilots. However, he not only demands of others but himself systematically perfects his skill in a combat plane.

On the days of preliminary preparation for flights, V. A. Tyshevich is constantly at the subunits, where he not only checks the preparations of the flight personnel but also gives useful methodological advice and practical recommendations.

Officer Tyshevich devotes much attention to flight methodological work, directing the activity of the methodological councils into the right channel; he constantly concerns himself about improving the teaching base, equipping the methodological classrooms, and raising the level of the commanders' methodological culture.

Watching the activity of this commander, you involuntarily ask yourself the question: Where does he get such energy, such diverse knowledge, such an ability to see the important thing in the work of every air commander, every specialist, and then direct the efforts of all to performing the main task, setting the example himself?

There can be only one answer. Like all the members of the great Party of Lenin, Communist Tyshevich understands clearly the great task that has been given him by the Soviet people.

Remembering the precept of his people, Tyshevich gives all his effort to his beloved profession both during wartime and during peacetime.

At the basis of his work, this battle commander has placed the teaching of all the pilots first to the level of second class and then to the level of first class. He

reasoned thus: an air unit can be combat efficient only when all the pilots are trained for combat operations in the daytime and at night under adverse weather conditions. In carrying out this task, the commander has encountered many difficulties: there were not enough instructors to train the flight personnel; the pilots were taught under adverse weather conditions not by their direct chiefs but by higher ranking ones, which retarded the general training.

Tyshevich first of all decided to train all the element commanders for instructor work in a short time. Almost every day he persistently taught the squadron commanders in a combat training plane the methodology of training element commanders, and they in turn taught the latter the instructor's art. The results of such work showed up very quickly. In a relatively short time almost all the officers of the supervisory personnel became pilots first class, while the rest of the pilots obtained a second class rating.

However, as before Tyshevich concerned himself with improving the flying skill of all the pilots, searching for ever new methods and forms of teaching, comprehensively and profoundly analyzing the progress of flight training. A profound analysis of the flight training often helps him to discover serious shortcomings in the teaching of the pilots.

He has done much work to train the pilots to intercept aerial targets in the most diverse circumstances at all altitudes. The first class pilots performed the missions only for "excellent", but some of them sometimes intercepted targets in the clouds at other than the assigned line. This made the commander think. What was the trouble? The pilots know well the technique of piloting, they have mastered the radar sight, the command post crew has been trained. It would seem that all the conditions necessary to make every intercept at the assigned line were present.

And then together with the squadron commander, V. A. Tyshevich took up the analysis of an intercept flight by stages. The analysis and computations showed that the reason for the shortcoming lay in the fact that the pilots had not practiced well enough the separate elements of piloting a plane in the clouds. It could be assumed that the pilots had not mastered as well as they should have the execution of vigorous turns with a bank up to 60° in the clouds at a command from the KP [command post]. As a consequence of this, in an intercept, especially in an intercept of a maneuvering target, when the interceptor must execute commands from the KP instantaneously, they performed such evolutions with a bank up to 30°, and consequently they spent much time in such a turn and the target managed to get away to a considerable distance.

The commander's suppositions were confirmed entirely. On the next flying day, he checked in a two-place plane how the pilots were executing turns with maximum bank by instruments and established that they had not practiced this element of flight enough. The pilots were given check flights in a combat training plane and then training flights in a combat plane. The result was that they all began to effect intercepts uniformly successfully.

Excellent training, a high degree of combat readiness on the part of the flight personnel, able leadership of subordinates — such are the evaluations of the work of Communist Tyshevich, who bravely defended his Motherland during the past war and who has been working selflessly during the postwar years.

PERFORMING MILITARY DUTY...

Lt. Col. F. A. VAZHIN

From beyond the horizon came a jet plane in a rush. The flight controller at the range did not manage to complete the sentence "I authorize attack", when the plane, its wings flashing in the sun, disappeared from view.

"There is an attack!" the officer remarked with admiration.

Soon there resounded the muffled burst of a bomb. When they measured its distance from the target, the flight controller was amazed.

"So far from the target! It cannot be!"

"Perhaps I didn't hear the call sign right and this was some young pilot?" he thought. But in the planned schedule, opposite the call sign reported from the plane he read once again: "Lt. Col. Rybak, Maj. Burdin."

After a check it became clear that the bomb burst had been measured correctly too. The flight controller was puzzled. The ground target had been attacked by a plane on board which was an experienced crew — unit navigator Hero of the Soviet Union Lt. Col. M. I. Rybak and squadron commander Military Pilot First Class Maj. V. P. Burdin — recognized masters of attacking ground targets. This was evident even from their "style" in the air.

Meanwhile Lt. Col. Rybak and Maj. Burdin were impatiently waiting for the report from the range. And when it arrived, the officers were chagrined, but they did not lose heart. The thing was that this was their first flight for testing one of the tactical methods of attacking a small-size target.

The tactical method that was being worked out by officers Rybak and Burdin was attractive in that when using it the pilot could approach the target from any direction and attack it straight in. This is very important in operations against targets located tactically deep.

The officers spent more than one evening working out this tactical method; they drew diagrams of the maneuver, made calculations. And the result was failure. Among the pilots of the unit there was a lively discussion. The majority of them ardently supported their comrades and gave valuable advice. However, there also were skeptics. Even before the test they were doubtful of success and after the unsuccessful flight they said:

"Since the best fliers didn't succeed there is nothing to be done."

But Lt. Col. Rybak was adamant. Considerable experience as a flier suggested to him that in a certain aerial and ground situation this tactical method can be very effective. The officer had faith in success, knowing that persistent creative searching cannot but produce results.

That evening Rybak and Burdin were walking home together. For a few minutes they were silent but they were thinking about the same thing.

"Well, Mikhail Ivanovich, it can be said that we have done our job, we computed it and tested it," Burdin broke the silence.

"What do you mean, done?" Rybak interrupted him. "You want to say that now let them send instructions from above, give us the methodology of executing the tactical method."

"I don't want to say that, but then we would be right. And now... What if we have another failure? They will think that we have forgotten how to fly," Burdin would not be quiet.

"Right, right... Unfortunately, we do not yet search enough for the new, the advanced. And yet we still have to fly."

"That's true," remarked the major after thinking a little.

Lt. Col. Rybak recalled how during the Great Patriotic War Soviet pilots creatively approached the utilization of tactical methods.

...It was 1945. In the area of a large city the Soviet troops were crowding a large grouping of German Fascist troops against the Danube River. One of the enemy's routes of communication with his rear was a concrete bridge across the river. Over it the enemy was bringing up guns, ammunition, and reserves. In addition, utilizing the bridge he could withdraw his troops from the encirclement.

Several times Soviet pilots flew out on a combat mission to destroy the bridge. However, the enemy had concentrated so many AA guns and fighters there that all attempts failed.

Meanwhile, the situation became more and more critical. The bridge became the decisive sector on which the defeat of the enemy grouping depended. Delay in destroying it might lead to a breakdown of the entire operation of our troops.

Then the commander of the front ordered: "Send the best trained pilots against the bridge!"

Among them was attack bomber pilot Mikhail Ivanovich Rybak. The officers gathered together to outline the flight plan and select the tactical method to overcome the enemy's antiaircraft defense zone.

Several variants were discussed. It was possible to fly to the target and deliver the strike from a medium altitude. The greater the altitude the lower the effectiveness of AA fire. But after a thorough evaluation of the antiaircraft defense of the bridge, this variant was rejected; after all, in this case the enemy could concentrate all his fire on the planes approaching the target. Furthermore, the probability of hitting the bridge was much less.

Again and again the pilots analyzed the situation and studied the disposition of the enemy's AA batteries and the approaches to the bridge.

The major portion of the AA guns protecting the target stood on an elevation situated not far from it. Studying the map, the officers turned their attention to the fact that a street with multi-storey houses approached the bridge from the enemy's side.

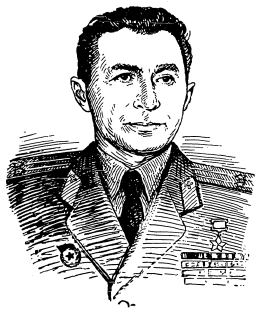
"What if we come out in the rear of the Fascist grouping and come up on the target along this street?" suggested one of the pilots.

"This, I think, is right," said Rybak. "I have flown in this area. You can go along the street at treetop level."

The suggestion appealed to the pilots.

The commander approved the bold plan and gave the order for a combat sortie.

At the appointed time the attack bombers rose into the air. One of them was flown by Mikhail Rybak. The formidable craft rushed headlong along the street, almost touching the electric wires. On the right and on the left, buildings loomed above the plane. Helpless anger seized the enemy AA gunners when they spotted the Soviet attack bomber. However, the Fascist batteries could not fire. Only



Hero of the Soviet Union Lt. Col. M. I. Rybak

here and there machine-gun bursts and solitary cannon shots were heard in the wake of the attack bomber.

Ahead the columns of the bridge could already be seen. Rybak smoothly pulled the stick toward himself and executed a zoom. At an altitude of 250 m, having aimed accurately, he pressed the bomb release button. A mighty explosion tossed the plane. Levelling off the craft, Rybak went off at treetop level to his home airfield. After him, other attack bombers came up on the target.

And soon a scout reported: "Bridge blown up!"

By order of the Presidium of the Supreme Soviet of the USSR, Mikhail Ivanovich Rybak and the other attack bomber pilots were awarded the high title of Hero of the Soviet Union.

...And now Lt. Col. Rybak recalled this episode. Under difficult military circumstances, creative searching helped more than once to find a way out of a difficult situation.

Under postwar conditions, aviation equipment and armament have changed. The jet planes in which Soviet pilots now fly are much better. And this inevitably reflects also on the methods of their combat application.

M. I. Rybak and V. P. Burdin could not reconcile themselves to the failure. They had made only the first trial flight. And although it did not produce the desired results, the fliers were nevertheless convinced of the desirability of the new tactical method, and had obtained interesting material for analysis.

Next day they again bent over sheets of paper. It was necessary to find the reason for the bomb's great deviation, and for this it was necessary to check all the calculations, to study the plane's maneuver and the pilot's actions.

First of all, Lt. Col. Rybak and Maj. Burdin analyzed the maneuver that they had executed in making the approach to the target. Was there not a mistake here?

The fliers had begun the maneuver for dropping the bomb precisely at the designated spot. This was also confirmed by the observations of the flight controller at the range. The assigned G-loads and angles had been maintained; no involuntary banks had been made. Repeated calculations showed that the maneuver for coming out on the target and dropping the bomb had been determined correctly.

"But was the moment of bomb release computed accurately?" Lt. Col. Rybak expressed his doubts.

"I remember well that we released the bomb at the moment when the position of the plane corresponded to that calculated and the angle was equal to the assigned one," replied the major.

"What then is the trouble? Are we on the wrong track?" thought M. I. Rybak.

"I think we have to check everything in the air once again," he said.

Maj. Burdin agreed. Reporting their observations to the commander, the officers obtained permission for the flight.

The plane was in the air gain. Maj. Burdin piloted it with special attention. Every element of the maneuver was executed with jeweller's precision. Then the moment for releasing the bomb approached -- the fliers literally glued their eyes to the gyrohorizon so as to determine the position of the plane precisely. The assigned graduation on the spherical scale approached the aircraft silhouette. Rybak pressed the bomb release button. But during the maneuver he noticed that in vigorous evolutions the spherical scale of the gyrohorizon apparently went ahead of the actual magnitude of the angle. "And we didn't take this into account. It is necessary to consult with the engineer."

But he did not want to draw final conclusions until the results of the bomb drop were known. And they were unfavorable again: the bomb deviated from the target in the same direction and for almost the same distance as in the first flight.

"Everything is clear!" exclaimed Rybak. A smile lit up his face.

"What's clear? What is there to rejoice about?" asked Burdin with vexation.

"Our calculations, Viktor Petrovich, are correct. The error has been found!"

And Rybak told of his conjecture.

"Let's go to the engineer at once!" urged Burdin. Having heard the fliers out, the engineer said:

"You are absolutely right. It is necessary to take this peculiarity of the gyrohorizon into account in vigorous maneuvers."

And then the officers went to the commander again.

"But this is only a supposition," he declared.

How could they convince him? In general the commander was right. And what if still another flight proved to be a failure? Could they insist on his permission?

"I think that the suppositions are correct," having thought it over, Lt. Col. Rybak said firmly.

"Well then, go ahead and fly again," agreed the commander.

With what excitement the officers prepared for this flight; what hopes they placed on it! And their persistence in striving for the objective set, their knowledge of the equipment, and their skill led to victory. The results of the flight exceeded expectations. The bomb, released with consideration of the correction, hit the target.

The fliers were overjoyed at the success. And how could they help but rejoice! Their tactical method had succeeded. However, there was still much to be done in order to make it the property of all the flight personnel of the units. After all, in attacking a ground target it is necessary to take into account the wind. It has an effect on the deviation of the bomb.

Encouraged by the success, the unit navigator busied himself with calculations again. The difficulty lay in that the plane could approach the target from any direction and attack it straight in. If the direction of the approach and the wind are known in advance, the situation is eased by the fact that the necessary corrections can be calculated even during the preparation for the flight on the ground. But the situation may develop in such a way that the direction of the approach must be changed in the air or an entirely different target attacked. Then the pilot is compelled to make all the necessary calculations in his mind in a very short time. How to make his actions easier? This is what Lt. Col. Rybak thought about.

He computed where the maneuver should be begun in order to take into account in executing it the plane's drift with different wind velocities and directions; he took into consideration the correction for the drift of the bomb during its fall. All this was again checked in flights.

Now it was necessary to practice the tactical method with the other pilots. Under the direction of Lt. Col. Rybak, diagrams of the maneuver were drawn on large sheets of paper and the necessary calculations were made. At lessons he told about the advantages of this tactical method and about the procedure for executing it. At first the pilots trained in the practice zone. After appropriate preparation, flying began. Lt. Col. Rybak and Maj. Burdin flew the pilots in "duals". In the air they demonstrated how to execute the maneuver, pilot the plane, take the wind correction into account, determine the moment of bomb release. The pilots mastered this tactical method and are now successfully applying it in practice.

For several flying days in a row, Hero of the Soviet Union Lt. Col. Rybak scarcely got out of the instructor's cockpit of a plane. But he felt no fatigue. As during the war after completing a difficult mission, the Communist officer obtained great moral satisfaction from recognition of the fact that his intense labor helps increase the combat skill of the pilots and, therefore, is necessary and useful to the Motherland.

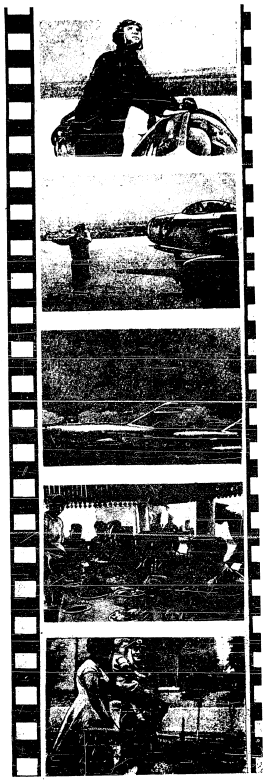
"OF THOSE WHO FLY"

This is the title of the film made by an amateur motion picture studio which was organized in one of the air units. The film was directed by Capt. G. I. Utkov and photographed by Capt. I. P. Patrikeyev. With the help of their sponsors — the workers of the "Gruziya-fil'm" studio — the film was supplied with a sound track and a commentary.

The motion picture film "Of Those Who Fly" deals with the life, the combat and political training of a leading air squadron under the command of Military Pilot First Class I. I. Tolokonnikov. The film bears out the well-known proposition that pilots are not born but made. It demonstrates convincingly that the making and indoctrination of a pilot is achieved through stubborn, persevering and continuous work.

The viewer sees training in progress in the classroom, at the trainers and photo-interpretation equipment. He sees the pilots preparing for forthcoming flights under the guidance of experienced methodologists, officers I. I. Tolokonnikov and V. N. Vetrov.

The formation of lofty moral and political as well as combat qualities is greatly influenced by Marxist-Leninist training. The film shows the pilots familiarizing themselves with a new textbook "The History of the Communist Party of the Soviet Union", and studying independently. The tutorial sessions are conducted by political worker V. F. Khar'kov.



In order to be equipped with full knowledge at all times, it is well to remember the war years. The veteran in the unit, Military Pilot First Class M. I. Orlov tells the young men about the hard fighting and combat traditions. No session goes by without a jolly joke.

In order to make fullest use of all the capabilities of modern aircraft, good physical training is necessary. The film shows the pilots working on special sports apparatus in preparation for flying at very high speeds and altitudes, and for withstanding G-forces while performing aerobatic maneuvers.

While the pilots practice their skills in classroom and trainers, painstaking servicing of aircraft for flights is in progress at the airfield. The film shows the top technicians: A. D. Zakharov, A. K. Gubaydullin, M. S. Troshin, V. L. Vospitanyuk. The planes and equipment they service work efficiently and without failures.

...Another working day dawns. After a good rest, the pilots leave for the airfield. The commander issues the last instructions before flights. And then comes the command "To your planes!" The pilots are off to their combat craft.

Here are shots showing Technician A. D. Zakharov reporting to Pilot V. A. Almashev that his plane is ready. The latter carefully inspects the plane. The aircraft are ready for takeoff. The pilots one by one climb into the cockpits. Seeing them off are the tireless toilers, the technicians who extend to their commanders their heartfelt wishes for an outstanding flight.

The aircraft are aloft. Down below, under the wings is their native land.

...Pilot A. F. Novikov is back from a high-altitude flight. Flight Surgeon A. M. Sheludchenkov is talking with him.

"How do you feel?"

"Fine, everything is under control."

The film shows the care that is lavished on the pilots. Here lunch is brought to the airfield -- out in the open it tastes especially good.

The flights are coming to a close. One by one the planes are coming in at the airfield. Mission accomplished. Now for home. Captain P. M. Nedzelyuk is met by his wife and small son, Sasha.

And on Sunday one can rest. What can be better than a little fishing? You can say the catch is poor but then what pleasure it is to sit a while with the fishing rod, to have some tasty fish broth cooked with one's own hands.

The film tells of how the soldier airmen maintain close contact with the young people at the factory. Guests arrive at the unit on Sunday; they are members of Communist labor brigades, the shock workers, and young engineers. In an atmosphere of friendship and animation they talk. In their turn, the workers invite the airmen for a visit.

At the conclusion of the film, we hear the words of the commentator: "Soviet airmen, inspired by the historic resolutions of the Twenty-First Congress and the June Plenum of the Party's Central Committee, are ever more broadly developing socialist competition which assists in our moving forward..."

A fine job has been done by the Party and Komsomol organizations in the unit. The film sustains the viewer's interest and inspires the soldiers to new endeavors and successful resolution of problems in combat and political training.

In the photos: Shots from the film "Of Those Who Fly".

Lt. Col. I. I. VUL

DISCUSSING THE SUGGESTED PREFLIGHT PROCEDURE

1. This We Must Do, But How?

In the article "Is it not Time to Modify the Preflight Procedure?" published in the magazine "Herald of the Air Fleet" No. 1 for 1960, Maj. Gen. of the Air Force M. I. Martynov and Col. N. I. Faddeyev point out a number of shortcomings in the currently practiced methodology of preflight preparation of the flight personnel, and suggest a different methodology. The very fact that this urgent problem is under discussion merits attention.

We cannot but agree with the authors that in connection with increased complexity of flying at high speeds and altitudes, the employment of various systems and control instruments, pilots must have firm theoretical knowledge and exceptionally thorough preparation.

They are absolutely right when they speak of increasing the amount of time allotted to independent work, and increasing the responsibility of the pilot and the commander for the quality of preflight preparation. However, there are certain propositions in the article which give rise to doubts.

The new methodology is too vague, while the new definitions -- "advance preparation", "immediate preparation" — are unconvincing.

The time for independent preparation must certainly be greatly increased. But where can we get this time? What can we eliminate? The article fails to answer these questions.

More than that. The article also proposes to substitute for the comparatively brief flight rehearsal a pilot checkout by the specialists. But such a checkout takes up more time. Therefore, it is not clear where the authors hope to get the time for independent preparation. After all, it is not possible to do away with the rest of the basic elements of preflight preparation — mission assignment, instruction for carrying out an exercise, and training sessions.

Furthermore, the article proposes that the procedure and methodology of a mission be studied independently long before the "mission assignment" schedule is compiled; the latter is usually made up no later than a month before the scheduled flights.

But, firstly, a pilot will scarcely have the time for preparing for a mission which is two or three weeks away. He has much greater need for reviewing the methodology of carrying out a mission which is scheduled for the next day, or the

day after. And besides, from the point of view of methodology, is it right to study something different than what one is doing? Is it permissible, for example, before low-altitude flights to study flights in the stratosphere, at night, or flights under adverse weather which are scheduled for a week or two weeks later? In our opinion, it is not.

Secondly, a pilot cannot remember the difficult complex of exercises which he has studied previously. He will have to review this just before his mission. Moreover, there will be changes in the communications and ground aids to navigation data, as well as in the weather conditions. Consequently, the amount of time for preparation will considerably increase on the whole.

Thirdly, a squadron commander who is usually very busy, should not be burdened further with the compiling of "flight missions". If 20-30 exercises are planned for each pilot, then he must be given 50-60 hours for working them out. Apparently, "advance preparation" has a number of serious faults and, in the form that the authors of the article have stipulated, it is hardly acceptable.

But how can a pilot's preflight preparation be improved? How can his time for independent preparation be increased? How can the personal responsibility of a crew for the quality of flight preparation be heightened? These problems can and must be solved!

We feel that we must not abandon the old and tried concepts which have been backed by an experience of scores of years -- the concepts of "preliminary and preflight preparation" — so precipitously. And it is not a matter of any terminology or definitions!

No matter at what speeds and altitudes an aircraft travels, no matter how complicated a mission, there will always be clearly defined two stages in the crew's preparation. During the first stage the crew studies the entire complex of flight elements which remain unaltered up until the beginning of a flight mission; during the second stage they study the elements which can undergo changes prior to the mission or in the course of carrying it out (weather, communications and ground aids to navigation facilities, the sequence and the takeoff time, etc.)

If more time is required for the first stage — since it is the basic one (4 - 8 hours), then preflight preparation requires 1 to 2 hours.

Let us examine the preflight preparation element by element.

The commander assigns the flight mission, informs the flight and technical personnel what the plan table is, and gives instructions on the special features of carrying out any one of the exercises. Unfortunately, it is not always true that the squadron commanders present the mission tersely and clearly. In attempting to inform the crews as fully as possible on the plan table, they enumerate all the details down to the very fine points. In my opinion, this tends to minimize the importance of the plan table as a superior's order. By unnecessarily lengthy explanations of the assigned mission, they cool off the pilot's interest. When they explain everything to him, demonstrate, interpret, and practically seat him in the aircraft cockpit, there is no longer any room left for active participation and initiative. Yet the main thing is that not only must the instructor actively participate, but mainly the trainee. If the commander can assign a flight mission tersely and clearly in fifteen to twenty minutes and give instructions on carrying them out, then there will be more time left for independent preparation.

A plan table can be drawn on the blackboard (this has become a firm practice), or copies of the original distributed for study in the elements.

Unfortunately, independent work as a basic form of officer training is firmly established only in military schools and academies and in individual courses of study, while in the units and subunits it is not always used correctly. The schools, of course, have a much better training base and a much greater amount of necessary literature. But this apparently is the only important consideration. The main thing is knowing how to organize correctly the process of independent preparation.

Even when a sufficient amount of literature is available, some staff officers and squadron adjutants include in the schedule lectures, group sessions, and sometimes even ordinary reading of some publications, thereby denying the trainee any opportunity for independent work; similarly, a repetition of familiar material makes the session dull.

The outlook is different when a thematic plan for the month is issued with a schedule indicating the hours for independent study. Then the sessions proceed in an organized manner in squadrons or elements (depending on the material and the amount of available literature). The officers make extracts, write outlines and assimilate the material and, whenever necessary, avail themselves of consultations with the commanders and specialists.

Checking on the degree of assimilation is mandatory. It can be conducted in the form of a seminar, a group exercise, or an examination.

The above-mentioned faults in the organization of theoretical sessions also hold true for preliminary preparation.

It is often possible to come across the following situation. Immediately after the commander assigns a mission, the service chiefs then give their "instructions". Each chief tries to present as fully as possible in the time allotted to him the well-known elementary facts or else spends much time explaining that which can be learned independently and without difficulty. Thus, the well-known proposition that the basic form of preflight preparation for the pilot (crew) is independent preparation.

After the mission is assigned, the crew must study it for the most part independently, make the necessary calculations, and memorize all the data needed for the flight.

An independent study of all these problems is within the capabilities of every crew member, since the content, the sequence and the method of carrying out any flight exercise are given in the manuals.

Especially tiresome are the repetitious readings aloud of articles of regulations and instructions. Unnecessary reviewing of that which the pilots know well and which they can read themselves must be abandoned. Very often much time is spent in reviewing that which is already very familiar, and this is always done with the idea "so that nothing untoward will happen".

At times overcautiousness results in a situation where a preflight preparation is repeated in full whenever flights are postponed to the following day because of weather. But this is a futile waste of time.

The subject matter covered by the ground training should be evaluated critically. There is much extraneous and even obsolete material included in the training schedules.

In flight preparations checking is very important. The commander must know how well a pilot is prepared for the flight, and whether the crew is ready to accomplish the assigned mission.

Usually the squadron commander is responsible for pilot preparation. And this is right: he is the main organizer, and he should bear the responsibility. But when the center of gravity of independent study is shifted to the element, the role of the element commander increases significantly. Together with pilots and navigators he clears up the difficulties and gets ready for the flights himself. Who better than he will know whether the crews are prepared for flight or not?

Therefore, a high degree of responsibility for flight preparation, conscientiousness, and discipline must be fostered in the element commander and the pilot.

If the element commander is well prepared, disciplined, and efficient, he will be able to conduct the training both in the aircraft cockpit and in the trainer.

It is our opinion that flight preparation always consists of preliminary (usually on the eve of flights) and preflight preparation. But the methodology and the forms for conducting this preparation may be different. We must strive to increase the flight personnel's time for independent work, to make the sessions more interesting, to heighten the personal responsibility of each man — particularly the pilot, the navigator, and the element commander — for flight preparation.

Col. V. A. KUZNETSOV,
Military Pilot First Class.

2. We Must Save Time for Independent Preparation

In his article "Is it not Time to Modify the Preflight Procedure?" Maj. Gen. of the Air Force M. I. Martynov and Col. N. I. Faddeyev correctly point out the difficulties encountered by every air commander in training pilots for flights and, in broad outline, they indicate methods for overcoming these difficulties.

But what precisely are these difficulties? Often we encounter instances when a good deal of time is spent on preliminary preparation and yet the pilots are insufficiently prepared and where checking on the training is also superficial.

Experience shows that the matter here is essentially incorrect utilization of the time allotted for preliminary preparation, since the time spent on this by the crew was considerably less than the time allotted to the squadron.

Let us see why this happens.

There are, as we know, essentially four basic elements of preliminary preparation: mission assignment, independent preparation (studying the mission, preparing the map, the calculations, etc.), training sessions, and checkout.

Unproductive expenditure of time is due first of all to the unjustifiable practice of conducting preliminary preparation in sequence — element by element. Here some officers consider as the acme of organization the regimentation of each of the elements mentioned in accordance with the daily time schedule or at least with the schedule of study sessions. This alone indicates that time expenditure is divorced clearly and beforehand from the specific nature and the complexity of the planned exercises, with no consideration at all provided for the individual peculiarities of the crews.

With such an organizational setup of preliminary training, 1-2 hours are allotted, as a rule, for each element.

What is the result of this?

Let us say that two hours were allotted for navigator training on a bomber trainer in the subunit. All the navigators reported at the required time to the training session and the session was begun and completed on time. Superficially, the organization and procedure were faultless. But after examining the essence of this "procedure", we find that of the two hours allotted for the subunit, each navigator spends only ten to fifteen minutes for his own practice. The remaining time, as a rule, is wasted. Similarly, time is lost during problem assignment, especially when it is done for the whole unit and when the problem is assigned verbally to each individual crew. Much time is wasted in checking the preparation when the checking is done by the so-called "check-out rehearsal".

In the final analysis, it turns out that each crew makes productive use of only 40-50% of the time allotted to the subunit for preflight preparation.

The disadvantage of such time expenditure is apparent from the fact that, during the period of problem assignment, the crews which have already received the assignment do not wait for the rest of the crews, but begin studying the conditions under which the exercise is to be carried out, plotting the route, or filling out the forms, etc., i.e., independent study. But the crews do this unobtrusively in order not to hinder their comrades or to be reprimanded by the commander. During the check-out rehearsal one can notice how some of the crews "wind up" preflight preparation. They are forced to do this by the necessity of making up for the lack of time officially allotted for independent preparation.

We feel that changing over from a fixed sequence of working out the elements of preflight preparation to a parallel procedure will help remedy the situation. Here specifically we refer to a method which has already found practical application in some units and has been favorably evaluated by air commanders and flight personnel.

It is necessary, however, to emphasize from the very beginning that the parallel method mentioned here is not an end in itself, that it is in the final analysis only a form of organizing the work which -- as will be pointed out — makes for an essential improvement in the quality of preliminary preparation.

ADVICE TO THE ELEMENT COMMANDER

On a Pilot Trainer

Skills in complex flight elements, as is known, are lost with time, and in order to maintain them, systematic practice sessions are naturally needed.

Flying on instruments is, indeed, a complex element in the over-all system of pilot training. To maintain continuously the skills acquired in instrument flying is not possible for a number of reasons. And this is why even those pilots who have firm skills should continue to practice on the trainer.

At the beginning of the practice sessions, the element commander defines the training objective. Pilots who are just beginning to master instrument flying and those who have as yet mastered them poorly must develop skills in determining a

plane's attitude from the instrument readings while flying at various regimes, and they must also learn to establish and maintain an assigned regime and to distribute attention in sequence between the instruments during piloting.

Practice sessions with pilots who have already completed their instrument flying training are aimed at preserving the skills they acquired in flights.

Pilot trainers which are available in the units make it possible to resolve these problems successfully. True, it is not possible to reproduce on the trainer everything a pilot experiences in an actual flight on instruments because of the design peculiarities of the trainer. However, this is not a hindrance when the element commander knows well the peculiarities of the trainer. Such a commander will gradually introduce complications into the elements being practiced (setting in "turbulence", crosswind, descent at various vertical speeds).

Which elements and in what sequence they should be practiced the element commander knows by consulting the special program. Nevertheless, it is desirable to work out individual assignments for some pilots.

Before beginning the practice sessions, the element commander checks the operation and the readings of all the components and instruments on the trainer, and then assigns the pilots their problem. During the training session he closely watches the actions of the trainee, maintains the full radio contact with him required by the given mission, and checks the "flight", recording all the deviations from the assigned regime. Upon the completion of the training session, the commander holds a detailed critique of the "flight" and enters the grades in a special journal for each element practiced.

Superior and systematic training of a pilot on the ground will make it possible to improve the quality of his instrument flying under adverse weather conditions.

Col. I. V. PANIN
Military Pilot First Class.

What, then, is the method of parallel procedure in working out the elements of preliminary preparation? How is it organized and wherein lie its advantages?

With this method of work organization, the training sessions and the checkout of preparation (readiness) of crews for flight are carried out parallel with the independent preparation for the subunit; this procedure serves both as the methodological and the organizational basis of preliminary flight preparation. Up to 80% of all the time allotted for preliminary preparation is planned for independent preparation in the subunit. In the course of this preparation, pilots and navigators taking their turn on orders from the commander (navigator) of the subunit (or in accordance with the schedule) go to the trainer, taking only as much time as needed, and, after returning continue their interrupted session. The work of the subordinates is checked by the immediate superior in the course of all their independent preparation; at the end comes a readiness checkout. With such an organization, the crew does not waste time aimlessly. During problem assignment, consideration is also given to saving time for independent preparation. At the same time, the commander who organizes preliminary preparation reserves a definite amount of time for a discussion of problems, should the necessity arise.

ADVICE TO THE ELEMENT COMMANDER

Initial Flights on Instruments

Before you start teaching instrument flying, try to recall your first flight in an enclosed cockpit. While on the ground you had studied all the instruments thoroughly, you felt that you knew the cockpit as well as the fingers of your own hand. But then you went aloft in a dual control aircraft. You have pulled down the blinds, shutting off the horizon and the ground below, and you were left alone with the instruments and the controls.

And then what? The cockpit immediately felt confining. Even though you had "flown" many times in the trainer, now everything seemed somewhat different: it was more difficult to check the readings of the instruments, to locate toggle switches, knobs and control levers of cockpit equipment. Attention was scattered.

What was this? A lack of preparation, confusion? No. You had an adequate amount of knowledge, your primary skills were also sufficient, but you were unskilled in using them correctly in flight. Never forget this and always be fair towards the pilot whom you are training.

Know your pilot: what he does well and what he has yet to learn. Do not fail to give him a ground checkout. When he is already seated in the cockpit, ask him a few questions about working with the apparatus and on the sequence of observing the instruments. Talk to him. Try to create a quiet, business-like atmosphere. If he is nervous, reassure him. Sometimes a joke helps.

On the first flight, when the pilot draws the blind, take over the controls yourself, show him how to fly the plane straight and level. Then tell him to repeat your actions. During the next flights turn the initiative over to the pilot, let him do everything himself. Do not be hasty in giving him help when he makes an error. Check to see whether he notices his own mistakes and whether he can correct them independently. If he fails to notice his mistakes for a long while, prompt him over the intercom, let us say, like this: "Bank!" or "Speed!". Should this prove insufficient, then explain what kind of bank, or whether the speed is too high or too low. When the pilot does not react even to this or when he repeats the mistake, take over the controls and show him once more how to act correctly. If, on the other hand, the pilot makes gross mistakes and does not notice them, then this means that he is poorly prepared for the flight. He should not have been permitted to fly.

During the flight, speak and act calmly. Strive persistently in having the pilot maintain precisely all the flight regimes and carry out correctly all the maneuvers. Make an effort to determine the reason for every mistake: most often it is the result of violating the sequence of instrument observation. For this reason, remind the pilot of it now and then, calling off the instruments in the sequence in which he must observe them.

In every case call the pilot's attention, first, to the instrument and then to the action which is required of him. This gets him into the habit of thinking for himself, exercises his faculty of observation, and develops in him confidence in instrument reading. If a pilot makes mistakes in flight, but notices and corrects them himself, do not bother him — he is on the right path. He already sees everything and can do much. He needs practice and more practice.

Do not criticize sharply: the trainee may lose confidence and will make even more mistakes. If prompting or showing does not produce quick results, then help the pilot. Begin by piloting the plane together with him. Show the pilot where he must look, what he must do and then gradually withdraw your participation in the joint control. Without noticing, he will learn the correct procedure of observation and operation of controls.

Remember that at the beginning the very simple flight elements should be practiced, and then, gradually, a transition should be made to the more complex. For example, when flying straight and level, teach the pilot, first of all, to notice any deviations from the horizon (climb, descent), then banking, and then to maintain the heading. In instrument flying the simplest elements are those which require less attention.

Bear in mind that the pilot does not see the surrounding airspace and that you are the only one who scans it. Watch closely that the pilot stays within the zone or the flight pattern, that he maintains correct radio contact with the flight controller. Do not violate any flight service rules yourself -- you are solely responsible for flight safety. In spite of being very busy watching the actions of the pilot, do not forget that the aviation equipment should be operated competently, and the flying time watched closely.

Try to notice and remember (write it down if you prefer) the pilot's mistakes. After the flight explain everything in such a way that the pilot understands why he made those mistakes and has no more questions in his mind.

Ponder the results of the mission. Give the pilot a fair grade for individual flight elements and for the flight as a whole instead of giving him a general grade. Do not give him too high a grade; this will not benefit the pilot, but will do him harm: later you will have to give him additional flights.

Make full use of your authority. Carry out your duties with diligence, foster in your subordinates initiative, independence, and self confidence. Train the pilot to fly on instruments confidently and boldly.

Col. Ye. V. SUKHORUKOV.
Military Pilot First Class.

Now let us examine in greater detail how each instructor officer organizes his work in the parallel method of preparation.

On the eve of the preliminary preparation, the training time is scheduled by the headquarters. A critique of the preceeding flights can be planned, for instance, for the beginning or the end of this day. The beginning and the end of the preliminary preparation is determined in advance, the classroom is assigned for each squadron where the flight personnel will prepare for flights. Each subunit is given their time to work on the training apparatus, and the time for using the literature and visual aids; instructor personnel is assigned for checking out the preparation in the subunits. Obviously all this must be reported to subunit commanders.

Even before the preliminary preparation begins, the subunit adjutant receives the required aids and literature or secures their individual distribution; he also prepares the classroom appropriately for independent preparation.

Problem assignment must, as we have emphasized, take a minimum of time, and for this reason the crews' attention should not be burdened by problems which

do not concern them. In our opinion the experience of some units deserves propagandizing. In those units the problem is written with chalk on a special board ahead of time, and the crew does not hear it but reads it. This procedure does not, of course, exclude oral explanations or clarification. The problem, as a rule, must be given in the classroom which was assigned to the subunit for independent preparation. We feel that it is not advantageous to assemble all the flight personnel for problem assignment, even in those cases when the whole unit is preparing for flight.

The name of young airman, Communist Drygin has long since become famous outside the unit.

Many months of persistent training together with the help of his comrades in arms and the advice of the old experienced pilots produced unique results. While carrying out a gunnery exercise against a ground and aerial target for a prize, the young pilot scored 960 points of excellent gunnery.

Now pilot Drygin is called an aerial sniper.

In the photo: Senior Lt. G. M. DRYGIN.

Photo by K. G. KULICHENKO

The preparation assignment of crews must indicate: the number of the exercise; the conditions under which it is to be carried out, if they have not been provided for in the instruction publication; also the flight route, and the time when the preparation must be completed (as a rule it is the same for all the crews). In addition, it is well to indicate at the very start the time of the training sessions for each member of the crew. Flight time can be given to the crew either at the beginning of the day or at some other time during the preliminary preparation.

Independent preparations are organized efficiently and checked closely. There is no place here for drifting. First of all, the subunits must not depend on each other when using the basic diagrams and methodological lay-outs. For this there is only one solution: every subunit must be provided with the necessary diagrams and lay-outs. Every crew must be provided with instruction publications. The procedure for using some editions which are available in limited numbers is established by the subunit commander.

Each crew must thoroughly conceive the forthcoming mission in terms of space and time. For this purpose, the rule must be adopted that a pilot of a multiplace aircraft compile a graphic flight plan just as a navigator does.

In the course of independent preparation, the commander, navigator and other key personnel in the subunit and unit assist the crews which need help, without, however, lapsing into detailed supervision, but striving to see that each crew member master thoroughly and precisely the sequence of actions aloft.

It is best that the element navigator begin the navigator training sessions with one or two subordinates, while he, as a rule, practices independently. Pilot training sessions on the appropriate apparatus are organized similarly. Training sessions in aircraft cockpits under favorable conditions (extensive experience on the part of the flight personnel, absence of breaks in flying etc.) are permissible, we feel, for the purpose of saving time when held not on the day of preliminary preparation but on the flying day itself a certain time before taxiing out. The radio gunners and other members of the crew are trained under the supervision of the proper specialists.

A culminating and very responsible stage of preliminary preparation is the readiness checkout of the crews for carrying out of the flight exercise. When checkout is made by the so called "checkout rehearsal" method alone, it is nothing but formalism.

What are the forms and methods used for the checkout?

The element commander and navigator must work side by side with their subordinates during their independent preparation, must supervise their work and prepare themselves at the same time.

Because the squadron commander and navigator are more highly trained, they spend a minimum of time for their preparation, devoting the rest of the time to individual checkout of crews. The time given to the checkout of each crew can vary widely (from 5 to 20 minutes and more) depending on the nature of the mission, the level of training among those who are being checked out, etc. In addition to this, the preparation of the subunit must be checked out and guided by an officer specially detached from the administration of the unit, who observes the work of the flight personnel of the unit during the whole day or periodically and at the end of the day checks 1 - 2 crews comprehensively for endurance.

Observing the actions of his subordinates, the commander (navigator) of the subunit may note that some members of the crew do not have a clear idea of certain problems. In order to elucidate these problems and give the necessary explanations, he conducts a brief summary discussion, in the course of which he also evaluates the readiness of the subunit for flights and names anyone not permitted to fly or names the conditions under which he may fly.

In addition to the summary discussion, there may be held, if necessary, theoretical sessions or a study of publications, the contents of which is directly concerned with the forthcoming flights.

Such in brief are our basic suggestions on the organization of preliminary preparations with parallel working out of its elements.

This form of preparation, in our opinion, has two basic advantages. In the first place, a real saving in time is achieved for independent preparation; this actually makes it a basic type of preflight preparation. Secondly, the conditions are created for a thorough-going check on the readiness of each crew for carrying out the forthcoming mission.

The question may be asked: Is the method of fixed-sequence practice of the elements of preliminary preparation completely rejected? Of course, if two or more days are devoted to it instead of one, then such a form of preparation is possible. But such favorable conditions prevail very rarely.

A similar question may arise in connection with the check-out rehearsals. Are we definitely rejecting them? Of course not. Sometimes the rehearsal may prove expedient, but only as a supplementary form of mastering a lesson or of checking — for example, if a flight is carried out in a single combat formation of a unit (or subunit), where the actions of individual crews and groups are closely interconnected. The rehearsal in this case is used for practicing joint actions.

Col. M. I. DORFMAN

Foremost officer of a bomber unit, Military Navigator First Class Communist Capt. V. A. Gavrilov is getting ready for a night mission.

Photo by Yu. N. SKURATOV

MANEUVERING IN INTERCEPTION

Engineer Lt. Col. A. M. TARASENKOV,
Docent, Candidate of Technical Sciences

Interception of high-speed and high-altitude targets by fighter-planes involves a whole complex of problems. One of them is the choice of the plane's flight regime. A number of articles have dealt with the question of determining the most effective engine operating regimes, changes in speed according to altitudes, etc. It is also highly important to study the maneuvers which insure the success of interceptions.

The necessity of carrying out maneuvers is due to several causes. One of them is the peculiarity of weapons or of the sighting equipment. It is known that in order to use the fixed artillery weapons, for instance, when making use of semiautomatic sights, it is necessary to bring the interceptor into the rear hemisphere of the target on the pursuit curve. The attack in this case occurs at a very small angle-off, near 0/4. It is obvious from this that if the interception line is not located in the rear, behind the takeoff airfield, then, moving at first in the direction of the target, the interceptor will have to turn at an angle of up to 180° or even somewhat more. Thus, he can come out at a small angle-off into the rear hemisphere of the target.

It is interesting here to discover at what angle it is necessary for the fighter to turn at the command from the ground CP.

Let us suppose that an interceptor must be brought to within the range of the airborne radar station, after which it will change to an independent maneuver (Fig. 1). For the sake of simplicity, let us picture the airborne equipment's target visibility limit as a circumference; then let us find the vectoring point on it.

How is it possible to choose the target angle-off observed from the point of vectoring? Let us note right now that the angle-off of the attack will be different than what the calculations show, close to 0/4. For this reason let us consider only the criteria which characterize the fighter's maneuver. There are two of them: the location of the line and the probability of an intercept.

The farther the line of interception is from the defended object, other conditions being equal, the bigger is the angle-off of the target at the end of vectoring. Let's explain this. Let one fighter be brought to point A with an angle-off of 0/4, the

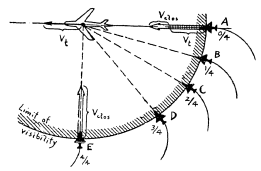


Fig. 1. Angle-offs of vectoring point.

other to point E with an angle-off of 4/4. The first one closes in on the target with a relative speed equal to the difference in speeds; the second, with the speed of its own flight. Clearly, the second fighter will close in at a much faster rate. It is necessary to add here that the required turn to the point of vectoring will be at a smaller angle and, therefore, will take less time. As a result, the second interceptor will overtake the target much earlier. The calculations show that if the angle-off of the target is increased at the point of vectoring from 0/4 to 4/4, then the pursuit range will be shortened 2—2 1/2 times.

But there is a factor which makes it necessary to lessen the angle-off of the point of vectoring. This is the probability of the pilot's own search for the target. The fact is that in practice it is almost impossible to bring out the interceptor to the end of the range of visibility without making some mistake both in angle-off and in the angle of sighting the target. For example, if you bring the plane to point D (Fig. 1), the fighter can have such a direction of flight that the target will be visible on his left. Then he will not fly along his pursuit curve, but with a minimum permissible radius. With a sufficiently large initial course error of the interceptor, and if its maneuverability is limited, the target blip may go beyond the edges of the airborne radar sight. Independent tracking will be terminated.

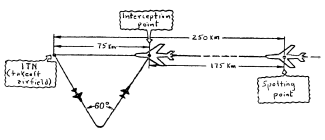


Fig. 2. Intercept diagram.

Therefore, whenever there is a mistake in vectoring, it is not always possible to close in on the target independently and it may be necessary to raise the question of the possibility of carrying it out at all. Clearly, the greater the angle-off of the point of vectoring, the greater will be the bank and the G-forces which insure tracking the target. This means that a course error here also will more likely cause the disruption of independent search. Calculations show that small angle-offs to the vectoring point are of considerable advantage when making an independent search.

Let us draw a general conclusion. If, in particular circumstances, it is more important to push back the line of interception of the target and if the airborne sighting equipment permits tracking the target reliably even if mistakes in vectoring are made, then it is better to increase the angle-off of the vectoring point. When small vectoring errors easily bring the target out of sight, then it is better to decrease the angle-off of the vectoring point.

We can assume that neither the weapons nor the sighting equipment will limit the angle-off of the attack, and that it will be possible to carry out the attack successfully from any heading. Is maneuvering then still necessary? It so happens that it is; since besides the reason described above, there is another reason for maneuvering prior to the attack connected with the geometry of the intercept.

Let us examine the following case. Let a target whose flight course is directed at the airfield from which the interceptor takes off be spotted at a distance of 250 km (Fig. 2). The altitude of the target is 15 km; its speed is 1500 km/hr. Let us suppose that the preparatory time from the spotting of the target until the fighter passes the initial point of vectoring will take 3 min. The time of climb to the altitude of 15 km and gaining the necessary speed will take, let us say, 4 min. Then, at the moment the interceptor comes out at the altitude of the target, the latter will be at the following distance from the airfield;

$$250 - \frac{1500 \cdot 7}{60} = 250 - 175 = 75.$$

It is clear that if the horizontal projection of the interception line is more than 75 km, then it is not possible to reach the point of interception without a change in the direction of the flight course. (See Fig. 2). With the distance of the horizontal projection of the climb track and the speed of 150 km, for example, it will be necessary to make a turn of about 60°. To intercept the target in the area of the takeoff airfield (which may be necessary in a number of cases), the plane turns up to 180°, irrespective of the type of weapons aboard.

It is clear that every maneuver of the target will also complicate the fighter's maneuvering. For the sake of simplicity, let us assume that the target does not maneuver.

It is known that the maneuverability of an aircraft depends to a large extent on the permissible G-load. For example, the radius of a banked turn greater than 60° may, with the given speed, be considered inversely proportional to the G-load.

When characterizing the maximal G-load, we subdivide it into the brief and the sustained. At high speeds the G-loads may be limited by the endurance of the pilot and the strength of the plane as well as by the plane's controllability.

In airplane descriptions there is usually a diagram of the maximum permissible coefficient of lift C_y as a function of speed or the Mach number of flight. If one has this characteristic he can find the brief G-load by the formula:

$$n_y = \frac{c_y \cdot V^2 \cdot \Delta}{16\frac{G}{S}},$$

where $\frac{G}{S}$ is the ratio of the plane's weight to the area of the wing;

$\Delta = \frac{\rho_H}{\rho_0}$ is the relative density of the air at the altitude of flight.

If the speed and the G-load are known, then the radius can be determined by the graph (Fig. 3).

An increase in flight speed results in an increase in the brief permissible G-load, which may be seen from the formula. A decrease in altitude and the weight of the plane—for example due to combustion of fuel—has a similar effect. It follows, then, that before reaching the altitude of the static ceiling, the fighter retains the capability of temporarily creating a noticeable G-load. Nevertheless, the radii of the turn will remain very large.

The sustained G-load is the one in which it is possible to continue the established flight with a constant speed. The physical meaning of this limitation is clear: the greater the G-load and the lift, the greater the drag. It is possible to create such a G-load that the drag will balance the thrust of an engine operating, let us say, in the afterburner regime. This then will be the maximum sustained G-load. With even a greater G-load the drag will exceed the thrust, and there will be either a loss in speed or in altitude of flight.

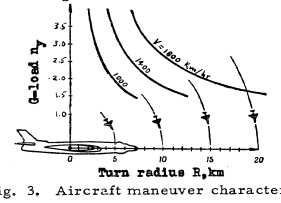


Fig. 3. Aircraft maneuver characteristics.

The characteristics of the maximum sustained G-loads are easy to obtain from a diagram of the range of flight altitudes and speeds in the description of a supersonic plane. Such a diagram is shown in Fig. 4 by the solid line. It shows the maximum altitude at the established horizontal flight at any speed. With a simple rearrangement of this diagram it is easy to get the necessary characteristics of the sustained G-load. For this it is necessary to draw curves equidistant (parallel) to the line of ceilings (solid curve in Fig. 4), shown by the broken lines. The broken lines are the limits of the established maneuvers with different G-loads, indicated above the curves.

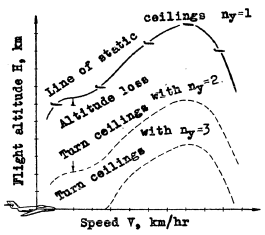


Fig. 4. The altitude limitations of maneuvers.

How far is it necessary to shift the lines? This is shown by the diagram in Fig. 5, where for each G-load one may find, independent of the flight speed and altitude and independent of the type of aircraft, the decrease in the maximum altitude of the maneuver compared with the maximum altitude of rectilinear flight. For instance, if the G-load is 3, the turn must be assumed to be at an altitude approximately 7 km less than the static ceiling.

If we have diagrams for a specific aircraft similar to those shown in figures 3 and 4, then it is possible to determine the radius of the maximum established turn at any altitude or speed.

Flight to intercept supersonic aerial targets will be very intense: in a short time it is necessary to gain a high altitude and speed, carrying out at the same time the necessary maneuver. According to what criteria is it possible to judge the correctness of the chosen regimes? One such criteria is the swiftness with which the interceptor accumulates the mechanical energy of flight necessary for attack and consisting of the energy of altitude and speed.

The carrying out of a turn involves an increase in drag; this means that when making turns the energy of flight accumulates at a slower rate and even decreases. From this we obtain the criteria for evaluating turns; they should be made so that the loss of the energy of flight will be at a minimum. In order to get an idea of how much energy is expended on a turn, let us take an example. Let a fighter with the engine shut off start his turn at an altitude of 20 km with M = 2. In order not to lose any speed, the fighter must drop down. In other words, the turn here will be made at the expense of the energy of altitude. Calculations show that in our example there will be insufficient reserve altitude even for a turn of 180°; the fighter will have to come down to the ground, without having finished it.

The regime of the turn is characterized, first of all, by the magnitude of the G-load or the angle of bank. Let's pose a problem like this: The interceptor, having taken off to meet the target, must then make a turn of 180° so that he can intercept it in the area of the takeoff airfield, as is shown, for example, in Fig. 2. It is possible to gain half of the necessary altitude while going to meet the target, then to

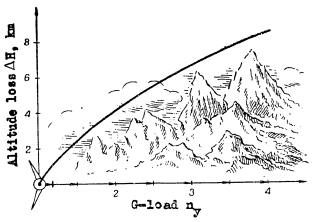


Fig. 5. Lowering of ceiling while turning.

make a vigorous turn at a constant altitude, after which it is possible to continue increasing the altitude in the reverse direction. Theoretical investigations and calculations show that it is disadvantageous to do so. The interception flight will take less time, if, instead of a vigorous horizontal turn, a more gradual turn of the trajectory is carried out along with the climb.

The physical explanation of the conclusion is this. In a vigorous turn, energy is lost at a fast rate, but it takes little time. In a gradual turn the loss of energy per second is less, but it takes more time. If you compare both factors, you will find that the gradual one is more advantageous. Let us note here that we are examining turns in the process of increasing altitude, and not the ones just before the attack. If the turn goes over to an attack, then it must be done as vigorously as possible.

In interception it is frequently necessary to make the turn during a zoom. In order to recover quicker from the zoom, in order not to "jump over" the target, it is sometimes necessary to create a negative G-load. In this case, it is necessary to keep in mind an interesting peculiarity of piloting: the plane must be banked in a direction opposite the turn. Let us illustrate this with the help of Fig. 6. To recover from the zoom faster and to change to horizontal flight, as we see, the lift is directed downwards. But then to turn, let us say, to the right, it is necessary to bank the plane to the left. The lift, or in the given case, the "downward" force will yield a horizontal component directed to the right.

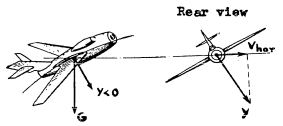


Fig. 6. Diagram of forces in a turn.

Let us examine another case. An interceptor that finishes the attack far from the place of landing, must, in order to return to it, make a turn of 180°. In order not to lose flight speed and altitude, the turn should be made in the afterburner regime of engine operation. But such a turn would waste much fuel at the expense of spare fuel for the return trip. Perhaps it would be better to shut off the engine and not to lose any fuel at all on the turn? But then flight speed and altitude will be lost. By the end of the turn the plane will have less energy of altitude; this means that the letdown distance will be reduced. Analysis shows that in such cases it is always useful to shut off the afterburner, after having determined, let us say, the nominal regime of engine operation.

And so, the process of intercept requires complex maneuvering. In order to carry it out intelligently, the flight crew must know well the different maneuvering capabilities of planes and must take advantage of them intelligently.

AT THE CP

Capt. D. P. VLASOV

As he walked out of the Command Post Maj. N. N. Zheleznov breathed in the fresh air deeply. The light frost was invigorating. The fatigue which was the result of many hours on duty began to pass away gradually.

Overhead he heard the drone of jet aircraft. High up in the sky a pair of fighters was rushing by. "They're returning from their mission", thought the officer.

With a long and attentive look he watched the silvery birds pass by. Only a few minutes ago he was giving them the flight course to the aerial target.

For a moment the eyes of the Major looked sad. It was a long time since he himself had flown. Now he had another profession, just as interesting as the previous one. But every time he saw the aircraft flying, he longed for the sky. The officer was used to the open sky. In the Great Patriotic War he had been a fighter-pilot and had made 217 combat sorties. Fighting in the air, he downed 7 Fascist planes. He was awarded five orders and many medals for his fearlessness and daring.

After the war Zheleznov flew jet fighters, piloting them in every kind of weather day and night. Later, the unforeseen had happened — he fell very ill. The doctors grounded him.

What to do? Where to use his knowledge and experience which he had acquired while serving in the Air Force for these many years? His friends, the commanders, suggested the job of ground controller. But he had only a hazy idea of the duties and responsibilities of the work. He decided to take a closer look. He went to the CP, inspected the equipment, looked into the work of the ground controller. The work proved to be complex, responsible, and interesting.

His first days on the new job were very difficult: he had insufficient knowledge, particularly in radio and radar equipment; he had no experience in vectoring fighters to targets. He had to learn from his experienced comrades; again he had to take up the textbooks.

Every day the job of ground controller appealed to him more and more. His skills improved and he acquired experience. Certainly, not everything went smoothly; there were slips — sometimes for which he was responsible, sometimes due to errors on the part of the CP crew. But failures did not discourage Zheleznov. He went on working persistently.

During the years of the last war, Vyacheslav Georgiyevich Bezyayev came to the Air Force regiment as a Master Sergeant. Zealously he began to master the art of flying and tied his own life to that of the regiment, which had become very dear to him. Years passed by. V. G. Bezyayev's mastery of flying grew and strengthened. His command skills continued to grow.

At the present time officer Bezyayev is a mature Air Force commander. The aviators of the unit in which he has been serving uninterruptedly for more than 15 years have made big achievements in combat training — 85% of the personnel are Outstanding Men in combat and political training. For successes in training they received the challenge Red Banner of the City Committee of the CPSU. For these successes great merit is due air commander, officer V. G. Bezyayev.

In the photo: V. G. Bezyayev

Photo by V. I. KOLESNIKOV

Captains K. Kh. Ikhsanov, N. S. Tryukhan and A. D. Suslov were also studying with him. Helping each other, they perfected their mastery of the job.

...The CP received a message concerning the appearance of an aerial target flying at a high speed.

How much knowledge and solid experience are necessary in order to choose in a limited time the most effective method of vectoring · The situation is such that if one vectors the fighter to a considerable distance away from the axis of the target's flight route, then it is very difficult to calculate the point of initiating the turn. Much depends on the accuracy of determining the distance and the nature of the target's maneuver. Sometimes it is necessary to recalculate at the last moment, which considerably complicates the work at the CP.

"What if we use a different maneuver? I should consult with the pilots", thought Capt. Ikhsanov.

The CP officers, together with the fighter-pilots, analyzed in detail the different methods of vectoring, expressed different suggestions and ideas. The opinion of Capt. Ikhsanov found wide support.

Especially appealing to everybody was the new method of shortening the time of flight of the fighter to the point of interception and the considerable simplification of the CP work.

Captain Ikhsanov soon had an opportunity to test his calculations in practice.

A fighter, piloted by Military Pilot First Class Capt. V. S. Golubev, took off to intercept an aerial target. The ground controller calculated his flight course accurately. The distance between the target and the fighter decreased rapidly. Ikhsanov once again checked the flight altitude of the target. When the fighter approached the "enemy" to within a definite distance, he gave the order to carry out the necessary maneuver. At this moment the crew of the target-plane saw the interceptor and attempted to evade the strike. But it was too late: Captain Golubev, after a vigorous maneuver, came out at the initial position for attack, quickly approached the target, and "destroyed" it.

"A very good method of vectoring! The 'enemy' does not have the chance to bat an eye, when you attack him,"Capt. Golubev later on explained to his friends.

The CP officers painstakingly worked at carrying out the different methods of vectoring effectively, depending on the weather.

In the region where their unit was based, for example, meteorological conditions change sharply and quickly, while the nature of the area produces on the radar screens the so-called "blips from local objects".

The skill of the operators and the ground controllers under such conditions consists of timely and correct evaluation of the aerial situation and of understanding the intentions of the "enemy". A good knowledge of tactics, of the capabilities of technical facilities, and experience are helpful.

In those cases when the target gets into the "blips of local objects" it is difficult to evaluate its location and the CP officers then turn to the following method. The PPI scope's scale is enlarged. The "blips of local objects" spread out, intervals appear between them through which it is easy to see the target.

The CP crew worked hard to shorten the amount of time necessary for interception. After takeoff, the fighters can climb in a straight line to the point of interception. But if the target is at a high altitude and if it is spotted late, the fighters reach the line of encounter before the target, but at a lower altitude; in that case the vectoring becomes more complex.

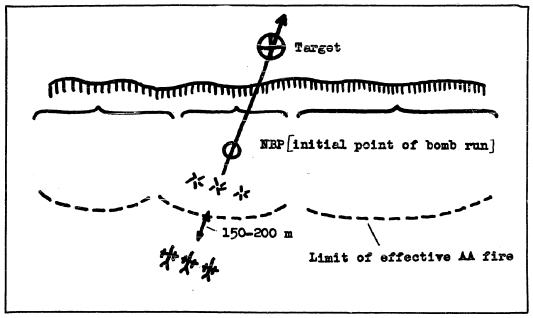
YOUR SOLUTION?

Where Did The Element Commander Make the Mistake?

At a tactical flight training exercise an element of jet aircraft was assigned the mission of making a strike against a target which was located approx. 5 km. away from the "front" line. The element commander knew that at the same time no less than three to five installations of automatic AA artillery of small caliber can fire simultaneously with an effective range in altitude of 3000 or 5600 m and no less than one or two batteries with an effective range in altitude of up to 8000 m.

For this reason he decided to strike from an altitude of 3500 m and, in order to remain within the zone of effective AA artillery fire for a shorter period before releasing the bombs, he decided to come out on the target with a straight-in approach at right angles to the front line.

Forty to fifty seconds before intercepting the bomb run in front at a distance of 150-200 m at his altitude of flight he saw the first flak bursts (see figure).



The element commander increased his altitude by 200 m. But after 12-18 sec. there occurred a burst which "hit" the right wingman.

What was the mistake on the part of the element commander? What maneuver would have made the attack on the target more effective?

In order always to intercept the target exactly at the right time and at the given line, the vectoring in some cases is calculated so that the fighters can go over to the regime of maximum climb right after takeoff, while further on the flight route the fighter can pick up the rest of the altitude.

The altitude to which the fighters must climb in the area of the airfield is determined according to the range chart and the time of flight, or by using the rule on which the rate-of-climb data are shown.

Major Zheleznov and Capt. Ikhsanov have a good idea of the sequence of actions on any leg of the route. They worked hard towards achieving mutual understanding between themselves and the fighter-pilots. And this is perfectly natural. The ground controller may know his work perfectly and yet, if he does not take into account the character, the habits, and the level of training of the pilot, it will be difficult to solve a problem. For example, Military Pilot First Class Capt. G. A. Demchuk reacts to orders almost instantly and carries them out exactly. But others — for example, Maj. A. D. Vdovin — must have several seconds to think things over. He does not like sharp banks and at times is over-cautious in his actions.

The CP officers closely study the subunit pilots and their individual peculiarities; to some they point out their shortcomings, while they themselves accept criticism of their work willingly.

On the eve of flight tactical exercises or after difficult intercept missions the fighter-pilots and the CP crew get together to discuss the different variants of aerial "combat" and the methods of interception of "aerial targets". As a result of these creative quests new methods are developed and interaction improves.

As a rule, the ground controllers are always present in the subunits whenever problems are assigned and during flight critiques.

The pilots in their turn are always interested in seeing which ground controller is going to vector them, since the CP officers also have their peculiarities and habits.

In the course of their work, Maj. Zheleznov and Capt. Ikhsanov often encountered various surprises. Once in the course of vectoring, at the moment the fighters were preparing to make a turn, two targets appeared on the screen and suddenly stopped at one point. "What crazy thing is this?"-- thought the ground controller; but, having evaluated the situation and the nature of the enemy "action", he understood the enemy's intent. Upon receiving the appropriate command, the fighters successfully attacked the aerial target.

An unceasing creative search for what is new and advanced — this is the quality which characterizes the work of the CP officers.

Recently, the following case occurred. An "enemy" bomber was spotted in the air. Major Zheleznov immediately ordered Military Pilot First Class Lt. Col. P. T. Konotop to take off immediately. The pilot quickly climbed to altitude and went to meet the target. When the target was only 10-12 km away, Maj.

YOUR SOLUTION?

What Should Be The Navigator's Answer?

Before takeoff the duty meteorologist briefed the flight personnel on the weather conditions in the area of flights. He pointed out that the pressure at the ground level was P_0 = 760 mm, and the temperature T_0 = -10°.

One of the navigators asked about the vertical temperature gradient and the pressure at the altitude of H = 8000 m. The meteorologist answered that:

$$t_{gr} = 0.4\frac{0}{100m}, \quad \text{while } P_H = 280 \text{ mm}.$$

Some of the comrades after formation asked the navigator why he needed such data. He answered that he wanted to take into account the bombing error in range due to a discrepancy between the actual atmospheric conditions and the standard ones.

To the question, "What may be the error and how to determine it?" the navigator answered: "Think for yourselves. After the flight I will tell you what I think." And the navigator took off on the bombing mission with H = 8000 m at V = 600 km/hr, and Θ = 21.0 sec.

The flyers had a heated argument on this matter. What were the ideas of the navigator and what could be the result of the flyers' argument?

Zheleznov ordered him to carry out the maneuver. The pilot understood the ground controller's intent; he promptly carried out the maneuver and appeared on the bomber's tail. All this happened so fast and so unexpectedly for the "enemy" that he was unable to employ any countermeasures.

In the friendly, tightly-knit team the sense of mutual assistance and support is highly developed. At a difficult moment each member of the team can help. Once Capt. Ikhsanov, who was vectoring the fighters, because of technical difficulties, had to terminate his work. This was noticed by another officer, Capt. N. S. Tryukhan who was seated at the extension PPI scope. He immediately took over and gave the interceptors the proper course. The targets were successfully attacked at the appropriate time.

Whenever a necessity arises, the CP officers never abandon the pilots in a difficult situation. A fighter was carrying out a scheduled mission above the clouds. His fuel was almost gone. To make a landing approach he needed a definite amount of time. He could run out of fuel. The pilot informed the CP of this. Captain A. D. Suslov quickly calculated the shortest route to the airfield, and transmitted to the aircraft the new course to the home airfield. The fighter landed straight in.

...It was night-time. At the CP work was going on feverishly. The fighters were scrambled to intercept aerial targets. The radar operator continually reported the data on their location. Leaning over the table, Maj. Zheleznov was plotting the planes' tracks on tracing paper. The mechanical brains seemingly expanded the walls of the building. Using the radar equipment, the officer "sees" what is happening at night-time many kilometers away in the air.

On the glossy side of the tracing paper, parallel to the blue line ("enemy"), there appears a red one (interceptor). From time to time the Major gives the pilot precise commands. In his mind he is there aboard the fighter flying in the night sky; he knows well how the pilot acts, what difficulties he meets, what kind of advice he needs at this or that time. And, whenever possible, he tries to help.

Now on the paper appears a second pair of lines and a third. The situation is becoming more complex. Unexpectedly, the "enemy" makes use of jamming.

But this was not what disturbed Maj. Zheleznov. From experience he knew that the "enemy" could make use of tactical maneuvers. And so it was. One of the bombers suddenly changed its flight heading. There was very little time for interception. N. N. Zheleznov gave the fighter a command to make a turn. While the pilot was carrying out the maneuver, Zheleznov made his calculations more precise and transmitted them over the air. After several seconds, in his earphones he heard the voice of the pilot: "I see the target! I'm attacking!"

The other target disappeared for a while. The Major made ready to vector on a no-wind track when the operator reported that the target had reappeared at the former place and then reversed its course. Everything became clear. The "enemy", having maneuvered, was trying to evade pursuit. But he was unsuccessful. Several seconds passed by — and again the ground controller heard the voice of the interceptor: "I see the target. Am attacking!"

These words again sound to Maj. Zheleznov as praise, as an expression of gratitude for his strenuous work. The two lines merged on the tracing paper. At the point of their intersection there stands a cross — the interception has been accomplished! Soon crosses appeared in other places also.

The enemy's attack was repulsed. Here significant help was rendered the airmen by their immediate aides — the CP officers.

THEY HELP TO INTERCEPT AERIAL TARGETS

Tonight the station was not switched on — there were no flights. The duty officer of the shift, Senior Technician Lieut. Nikolay Mereshkin, opened the door of the vehicle. The fresh frosty air rushed into the operator's compartment. He looked at the horns of the moon which were bent upwards and decided that the frost would increase by morning.

The telephone interrupted his thoughts; the phonecall came from the KDP [control tower]. At the neighboring airfield flights were going on. The flyers were practicing interception of aerial targets. Unexpectedly the ground radar station went out of order.

The order to switch on the station did not find officer Mereshkin off guard. The operators took their places and on the very first turn of the antenna they caught on their indicators a small light spot. This was the plane of the "enemy". They spotted him at great range and began to track him. The work was difficult. The target which was traveling at a high speed suddenly increased its altitude and sharply changed its course. It appeared that the "enemy" would be lost. But this did not happen. The operator concentrated all of his abilities and almost in no time he found the familiar signal. Soon the whereabouts of the other aircraft was established. The interceptor was flying five kilometers below the target.

Operator, Pfc. I. D. Mironov — in his unit he is considered to be the best high-altitude man — speedily and with very great accuracy determined the altitudes of both planes. This data was turned over to the ground controller. The plane of the "enemy" was intercepted.

The duty officer looked at the soldier approvingly and said: "Fine work, Comrade Mironov!"

Mereshkin saw the faces of the operator shine with joy, and smiled himself with satisfaction... Indeed Mereshkin knew better than anyone else how hard Mironov had worked before he mastered the job.

Operator Pfc. A. K. Evdokimov also worked well. The crew of the radar station spent many hours at the screens of the scopes; they were finding and tracking the targets and vectored the interceptors to them, giving the planes the coordinates.

And how many difficulties they came across! Often the screens showed simultaneously more than one blip. Sometimes, as if intentionally, they scattered over different sectors. It also happened that the required blip appeared very near the zone of local objects and disappeared in them. In that case the operators used the radar protective circuits which "swallowed" the false blips.

There was the following case. Flights were being made under adverse weather conditions. Suddenly, the main PPI scope went out of order. The situation became more complex, but the duty shift continued to work, giving data on the range and altitude according to the sector scan; at the same time the men were working on repairs.

The training did not come easy to the soldiers; the further they went the more difficulties they came across. And this is understandable. Each block, each detail of the radar station is based on numerous laws of the exact sciences.

Let us take, for exampie, its transmitter, with the help of which electromagnetic energy is created which is radiated into the air. It consists of many radio bulbs and units. In order to understand how it is built, it is necessary to understand the principles of tube generators and modulators, capacitative coupling, feedback, to know the properties of crystals, etc.

The crew of the radar station worked hard and persistently before it mastered its work. At present, Candidate for Membership in the CPSU, Officer N. S. Mereshkin is an operator first class. Mironov and Evdokimov have second class ratings.

The results of their work can be seen in the way they conduct the search, the tracking, and the interception of aerial targets; how they work under conditions of interference; how they help the interceptor-pilots attack the enemy in the air. There was not a single disruption; the soldiers are always successful in doing their duty.

[over]

In the photo: Senior Technician Lt. N. S. Mereshkin and Pfc. I. D. Mironov in front of the radar station indicator.

Photo by V. N. BARYSHNIKOV

IN A HELICOPTER UNDER ADVERSE WEATHER CONDITIONS

Engineer Lt. Col. M. S. PETRENKO,
Capt. V. N. APANOVICH,
Military Navigator First Class

In a flight in a helicopter of the single-rotor type along a route, the crew must take into consideration that even when the course is properly computed and maintained, deviations from the assigned track are possible. They are associated with the fact that at the established powered flight regimes slipping arises due to lateral aerodynamic dissymmetry of the helicopter.

Such dissymmetry is due to the fact that the reaction moment from the main rotor, the lateral component of the thrust of the main rotor, and the thrust of the tail rotor affect the helicopter in the direction of flight. Furthermore, if there is a transverse bank, a component of the force of gravity is also applied in this direction. In order to control the helicopter successfully in an adverse weather situation, it is very important to understand the physical essence of the phenomenon and to keep it always in mind.

It is known that steady flight is possible on condition that the sum of all the external moments and the sum of all the external forces acting on the helicopter are equal to zero. However, in powered flight regimes with a zero transverse bank the force of the thrust of the tail rotor is somewhat greater in magnitude than the lateral component of the thrust of the main rotor and their resultant algebraic sum is directed to the left. Let us explain this by an example.

Let us assume that at some moment in powered flight there are acting on the helicopter the reaction moment of the main rotor $M_{m.r.}$, the lateral component of the thrust of the main rotor F_2, and the force of the thrust of the tail rotor F_1, and $F_1 > F_2$ (Fig. 1a).

Assume that at the point where force F_2 is applied, there are acting two opposing forces F_3 and F_4, each of which is equal to force F_1 (Fig. 1b). The lateral balance of the helicopter is not disturbed by the application of these forces, since their resultant is equal to zero ($R_{F3 + F4} = 0$).

Summing up the forces and moments acting on the helicopter, we find that the reaction moment of the main rotor is balanced by the moment of the pair of forces M_A (F_3, F_4), and as a result of the algebraic addition of F_4 and F_2 we obtain the

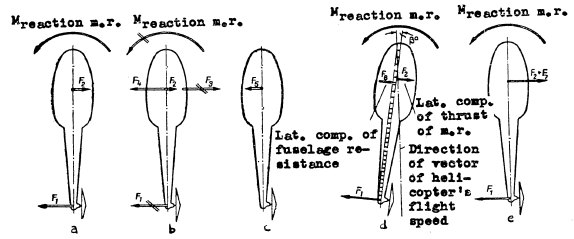


Fig. 1. Forces acting on a helicopter in flight.

resultant F_5, which is equal to the difference in the absolute magnitudes of F_2 and F_4 and is directed to the left ($F_5 = F_4 - F_2$). This is the lateral unbalanced force of the excess of thrust of the tail rotor (Fig. 1c).

To balance the excess of thrust of the tail rotor the helicopter must either go into a left slip or fly with a right bank.

In flying with a left slip, there is created an aerodynamic force of fuselage resistance F_6, which is directed to the right (Fig. 1d). With a constant forward speed at one and the same flight altitude, its magnitude depends on the angle of slip. With an increase in the angle of slip, the lateral force of fuselage resistance will increase. Consequently, in powered flight without bank, in order to balance the helicopter laterally an angle of slip is necessary such as to maintain the equality $F_1 = F_2 + F_6$.

In powered flight without slip, the helicopter can be balanced laterally only by banking to the right. In this, the lateral component of the thrust of the main rotor increases, and there arises a supplementary lateral component of the weight of the helicopter F_7 (Fig. 1e). A balance of the forces acting on the helicopter is achieved with the equality $F_1 = F_2 + F_7$.

It has been established that in horizontal flight an Mi-4 develops a left slip, which is eliminated by banking the helicopter to the right. The bank is insignificant, and in practice the pilot may not notice it.

The slip of an Mi-4 helicopter at an indicated speed of 140 km/hr is about 4° to the left.

Under these same conditions, but in flight without slip, the magnitude of the bank to the right does not exceed 1.5°.

The change in the angle of slip in relation to the indicated flight speed with a zero bank is shown in Fig. 2, from which it can be seen that as the horizontal

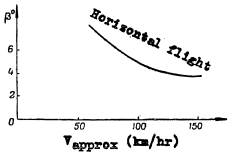


Fig. 2. Change in the angle of slip as a function of the helicopter's flight speed in the absence of bank.

flight speed increases the helicopter's angle of slip is reduced. This is due to the fact that the lateral force of the helicopter's fuselage resistance increases in proportion to the square of the flight speed, as a consequence of which the balancing of the excess thrust of the tail rotor is achieved at high speeds with smaller angles of slip of the helicopter.

From an examination of the balance of external forces it is evident that for a helicopter of the single-rotor type the balancing of the force of the thrust of the tail rotor, and also that of the transverse force of the main rotor, can be achieved either by creating a bank or by utilizing the transverse aerodynamic force of the fuselage.

Thus, a helicopter can fly without a bank and with a slip, without a slip and with a bank, or with simultaneous bank and slip.

On the basis of flights we have come to the conclusion that the pilot will not notice insignificant banks (1.5-2°), and this has a decisive effect on the helicopter's angle of slip, the magnitude of which is not constant even for the same flight regimes.

As experience shows, a bank of the magnitude of 3-5°, and consequently the angle of slip also, can be changed in flight by utilizing the trimming effect of the transverse automatic damper — the transverse "trim tab". With very slight deflections of the helicopter control stick, a constant bank is created by the transverse "trim tab", not only to the right but also to the left.

The relation between the bank and the helicopter's angle of slip with the positioning of the transverse "trim tab" leads to the fact that even in flight at the very same regime the angle of slip depends on the specifics of utilizing the transverse "trim tab" and on the accuracy of adjustment of the angle of transverse tilt of the ring of the automatic swashplate.

In flights in Mi-4 helicopters, it has been established that with established powered regimes in horizontal flight at speeds from 60 to 170 km/hr the angle of slip changes from 10° to the left to 3° to the right.

Irregular changes of the helicopter's angle of slip cause variable errors in determining the drift angle and the direction and velocity of the wind. And this leads to errors in navigating helicopters, especially in an adverse weather situation and over terrain without check points.

While it is easy to correct a helicopter's deviation from the assigned track under normal weather conditions, it is more difficult to do this under adverse conditions.

The way to improve the accuracy of navigating helicopters of the single-rotor type under adverse weather conditions lies in a new methodology of using the transverse "trim tab". In our view, for each steady powered flight regime there should be computed the transverse angle of tilt of the ring of the automatic swashplate, so that the transverse balance of the helicopter is achieved by balancing the force of the thrust of the tail rotor by the sum of the forces of the lateral component of the thrust of the main rotor and the lateral component of the weight of the helicopter.

This means that in flight at each regime the equality $F_1 = F_2 + F_7$ (Fig. 1) is maintained.

Thus, the cause of slip disappears. The flight of the helicopter will proceed with an insignificant, practically imperceptible, bank, but without slip or with small angles of slip that have no essential effect on the accuracy of navigation.

However, in modern helicopters there is no instrument that controls the angle of tilt of the ring of the automatic swashplate in flight. How then to establish the given transverse angle of tilt of the ring for each established powered flight, especially if it is taken into account that the angle of tilt for different regimes changes not merely in degrees but even in minutes of an arc?

The angle of the transverse tilt of the ring of the automatic swashplate depends on the magnitude of the deflection of the control stick from the neutral position. In steady flight the control stick is held in the given position by the spring mechanism of the automatic damper, which creates a trimming effect.

The position of the spring mechanism is checked by the readings of an instrument. Consequently, with a zero force on the stick, for each angle of transverse tilt of the ring of the automatic swashplate there corresponds a strictly determined deflection of the transverse "trim tab" and the readings of the needle indicating the position of the transverse "trim tab".

By drawing up a graph of the transverse angle of tilt of the ring of the automatic swashplate as a function of the position of the transverse "trim tab", it is possible to indicate in what position the transverse "trim tab" should be at any established powered regime in order to ensure that the helicopter will fly without slipping.

Inasmuch as the transverse angle of tilt of the ring of the automatic swashplate must be determined with a high degree of accuracy, the precision of the instrument indicating the position of the transverse "trim tab" should be increased. This can be achieved by a finer calibration of its scale and by improving the sensitivity of the sensing part of the instrument. Incidentally, it is best to graduate the scale of the instrument in such a way that it shows not the position of the transverse "trim tab" but the transverse angle of the ring of the automatic swashplate directly at a zero force on the stick.

In our opinion, successful effectuation of the above-mentioned work will permit a considerable improvement in the accuracy of helicopter navigation under adverse weather conditions.

Helicopters going out on a mission.

Photo by YU. N. SKURATOV

CHARACTERISTIC ERRORS IN CONTROLLING LANDINGS FROM THE CLOUDS

Maj. V. I. MINCHENKO,
Military Pilot First Class

Flights under adverse weather conditions are unthinkable without a great amount of precision in their organization and in controlling aircraft movement, very rigid and continuous checking on them, as well as painstaking piloting.

However, certain flight controllers and pilots still commit a number of errors — sometimes the most elementary ones -- and these lead to closure of the aircraft which threatens flight safety.

Let us analyze the most characteristic of these errors and try to establish their causes.

In penetrating the clouds and in approaching for a straight-in landing, despite the fact that the aircraft take off with adequate time intervals, they sometimes close to within dangerous distances and the flight controller must take immediate steps to prevent accidents.

The distance between aircraft decreases mainly due to the fact that the aircraft flying in trail cuts the track short. This sometimes happens because the pilot errs in maintaining the cloud penetration regime. But there is another possibility. Sometimes even aircraft of the same type but of different modifications have not only different rates of climb but also different forward speeds in the nominal regime of engine operation. They come out at the assigned level at different distances from the takeoff airfield. Consequently, they also make the turn over the PRS [homing radio station] at different distances from the airfield, i.e., some of them cut short the route.

All this testifies to the fact that it is impossible to disregard different vertical speeds or errors made by pilots in maintaining the climb regime, since otherwise dangerous closure of aircraft may take place even when they take off with time intervals of 4-5 min.

In practice it has been established that, when the time for beginning the turn over the PRS is reckoned from the moment of takeoff, a mistake in coming out at the right level and, consequently, in determining the point for beginning the turn will be discovered and eliminated by the pilot himself.

We think that it is wise to establish a flight time from the moment of takeoff to the beginning of the turn to the PRS, which the pilot may reckon with great accuracy.

Here an error in coming out at the point for beginning the turn arises due only to incorrect maintenance of forward speed in penetrating the clouds and in timing. Such an error is insignificant in comparison with the one mentioned above and it may be disregarded. Thus, if the flight is being made at the 4000 m level, and the pilot commits a speed error of ±20 km/hr and a timing error of ±10 seconds, the track will be shortened by about 6 km.

The flight time up to the point of turn must be established in such a way that the aircraft of all modifications whose most effective true rates of climb are identical but whose actual rates of climb are different will be able to reach the assigned level. For aircraft having lesser or greater true rates of cloud penetration, the time must be correspondingly increased or decreased enough so that the point of beginning the turn will be at the same distance from the airfield. For instance, if for a MiG-17 aircraft, flying at a level of 4000 m, the flight time up to the point of turn may be set at 4 minutes, then for an UTI MiG-15, penetrating the clouds with V=620 km/hr, the time may be 4 minutes and 40 seconds.

In order to avoid head-on flights, those aircraft headed for the PRS after the turn and which have come out at the right level, must fly towards the point of beginning the turn 200-300 m lower.

With such a method of penetrating the clouds upward the position in the common stream of aircraft movement in the system is most accurately maintained and flight safety is guaranteed. Also, safe time intervals between aircraft are reduced and, consequently, the capacity of the landing system during training flights is increased.

Other errors are also encountered in controlling flights.

Recently an element took off to practice aircraft assembly between cloud layers and break-up for landing with safe time intervals of 20 sec. Because of poor weather analysis, it was not established in time that the two layers of clouds had merged. After the leader reported that it was impossible to assemble, the decision was reached: all the crews were to go in for a straight-in landing.

The flight controller decided to disperse them to safe distances and altitudes, assigning the pilots the speeds and the relative flight altitudes shown in the figure.

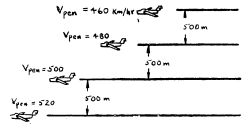
However, after the aircraft came out at the PRS no dispersion in distance took place at all. Why? Because the true speeds of all the aircraft were approximately the same, although an aircraft flying above was assigned an instrument speed 20 km/hr less than an aircraft flying below.

Experience shows that the increase in true speed at altitudes of 3000-6000 m with V = 500 km/hr amounts to 30 - 40 km/hr for every 1000 m. That is why the aircraft did not disperse in distance. Flight safety was maintained only by dispersing them in altitude.

If the flight controller had assigned the speed in accordance with a descending stagger, i.e., had ordered every aircraft flying below to reduce speed by 20 km/hr, then the true speeds of the aircraft would have differed by 35-40 km/hr and the distance between them at the time of coming out at the PRS (≈ 6 min.) would have increased by about 3.4 - 4 km.

The most competent action on the part of the flight controller would then have been for him to decide to have the aircraft turn to come out on the PRS in succession.

In separating aircraft to safe distances or in increasing the latter at a predetermined angle after the PRS has been passed above the clouds, some flight controllers



commit the same gross mistake year after year. They alter the flight speed of the aircraft in order to increase the distances between them. However, such an increase in distance leads to the aircraft's beginning the turn not at a predetermined point which must be equidistant from the airfield for all the aircraft in flight. But once an aircraft turns at some place other than the predetermined place and the aircraft in trail at the predetermined point, a cutting short of the track occurs similar to the case discussed above during penetration of the clouds upward.

Here the distance between the aircraft which is the result of the difference in speeds is shortened by two magnitudes after the turn to the landing course.

It is not surprising that, with a small initial distance and a change in speed of 50 km/hr, overtaking is possible. When thor. fl. = 4 minutes, the distance is shortened by 6.7 km. This means that, if the aircraft come out at the DPRM [outer homing radio beacon] with a time interval of one minute, as the result of an increase in speed of 50 km/hr of the plane ahead or of an equal decrease in speed of the plane in trail, the distance between them after they come out on the landing course is radically decreased.

A change in speed not only does not make the flight safe, but, on the contrary, creates causes for flight accidents. It is difficult for the pilot to establish the point for beginning the letdown, since he cannot determine how much the distance between the aircraft and the runway decreased or increased as the result of a change in speed. As a result, he either comes out too soon or cannot penetrate the clouds. This is, in fact, what happened once.

There was a strong headwind. The time of horizontal flight up to the point of beginning the turn to the landing course was correspondingly reduced. All the aircraft, after coming out on the landing course, were higher than the predetermined glide path. When the flight controller assigned a vertical speed greater than the established speed, the planes found themselves below the glide path.

Why? Because the flight controller and the duty ground controller did not take one circumstance into consideration: letting down against the wind, aircraft have a smaller forward speed than the speed for which the graph for determining the vertical speed of letdown is computed.

Indeed, the letdown glide path at the flight altitude, the no-wind glide path, and the glide path figured on the basis of the wind will differ from each other by the magnitude of the wind velocity multiplied by the time of letdown, and at an altitude of zoom they will, in fact, merge.

Thus, with U_{av} = 60 km/hr and with a time of letdown on the landing course of 5 minutes, the point where the aircraft begins the letdown will differ from the no-wind point by 5 km, while the plane will be 1000 m above or below the glide path. With loss in altitude, the actual letdown glide path of the aircraft will gradually approach the estimated glide path for no-wind conditions.

The duty ground controller must, on each flying day, as well as when there are changes in the direction and the velocity of the wind, compute the glide path and draw it with a colored pencil on the graph used for determining the vertical speed of letdown. This will undoubtedly make it easier to control the crews.

TOURS OF DUTY BY PILOTS IN METEOROLOGICAL SUBUNITS

It is well known that, for the successful carrying out of flights, especially under adverse weather conditions, the flight personnel must be able to analyze the meteorological situation on the ground and in the air.

How should this problem best be handled?

In our opinion, well-organized and purposeful tours of duty by the flight personnel in the weather subunits constitute one of the basic forms of training the flight personnel in meteorology.

On the basis of our experience, we have established that pilots who have acquired the necessary theoretical training in meteorology are quite able to master the principles involved in the analysis of synoptic and local maps and can learn how to prepare a short-range weather forecast.

In the weather subunit where the chief is I. F. Tutov the tour of duty by pilots is carried out in two stages.

The first stage involves learning how to read quickly the symbols in the vicinity of the station on weather maps, drawing isobars, determining air masses, the location of fronts, i.e., learning how to process and analyze weather maps.

The second stage involves rough preparation and independent analysis of a current local map, taking part in the analysis of all the synoptic material, and — at the end of the day — independent preparation of a 24-hour forecast.

A pilot who has taken a tour of duty in a weather subunit first of all prepares a weather telegram (in code figures). The weather subunit engineer acquaints him with the meteorological instruments, and explains to him how one observes the wind, visibility, air pressure, temperature, and other meteorological elements and how, by using the code, a weather telegram is prepared.

Having drawn up the telegram, the pilot writes it out in the synoptic code. During his tour of duty he prepares no more than two of these telegrams, since there is no special necessity for a pilot to learn how to prepare weather telegrams. This is done only so that he may become more fully acquainted with the method of receiving the data which are entered on the synoptic and local maps.

A more important problem is teaching the pilot how to read the synoptic code symbols used on the weather maps. To learn this, it is suggested that he enter the

contents of 12-15 specially selected telegrams on local weather map blanks together with the indexes of weather stations. After doing this he easily begins to read the weather around the station. The weather telegrams should be selected in such a way that, after they are entered, it is possible to draw the isobars, determine the pressure systems, the air masses, and the line between them (front).

On this same local map the pilot on duty outlines with colored pencils precipitations, fogs, thunder-storms, and other weather phenomena; he locates air masses having different characteristics and draws a line of demarcation between them.

Then the engineer-meteorologist explains to him how to draw isobars; after these have been drawn, the pilot locates the pressure systems and writes "L" or "H" in the centers of low and high pressure. According to the direction of the isobars and the pressure tendencies, he determines in what direction the front will move and, depending on the type of front, indicates it with blue or black pencil.

The pilot processes and analyzes the prepared local weather map under the direction of the engineer or the duty meteorologist who questions him which helps him master the technique of handling this work.

By now the pilot on duty is prepared -- at least approximately — to draw isobars, to locate air masses with different characteristics and their fronts, to indicate on the latest current local map regions where there is precipitation and fog — all of which he has to do.

In analyzing the movement of pressure systems of fronts, the pilot on duty is given previous local and synoptic maps, on the basis of which he decides on the velocity and direction of movement of pressure systems.

Next, the duty meteorologist, preparing a synoptic map, invites the pilot to take part in analyzing it; but the pilot on duty prepares on his own the survey and forecast of synoptic processes and, on the basis of these, makes a 24-hour weather forecast.

For the sake of greater responsibility, the pilot definitizes his forecast with the duty meteorologist and then he goes to report to the commander.

It is unnecessary to prove that no pilot remains indifferent to a weather forecast which he himself has prepared. No matter how well it is prepared, all the work that has been done forces him to approach more objectively and competently the evaluation of the weather situation on the ground and in the air. And this must hold for the entire flight personnel.

The pilot's tour of duty in the weather subunit is preceded by classroom sessions in meteorology (they are conducted within the scope of the general program). In addition, at these sessions a study is made of the climatic peculiarities of the flight region and local signs of changes in the weather. Here special attention is paid to the character of the weather and flight conditions in different sectors of pressure formations and to the stability of air masses.

Having attended the lectures in meteorology and having worked in the weather subunit under the direction of the weather specialist, the pilot will analyze the weather situation a good deal better. Such a way of organizing the training of the flight personnel in meteorology, in our opinion, is very effective and provides for the establishment of much closer creative contact between the flight personnel and the weather specialists.

Engineer Capt. V. V. ZHUKOVSKIY

WHY WAS THE MISSION NOT CARRIED OUT?

Engineer Col. V. I. SNEZHKOV

It is hard to imagine that such seemingly harmless objects as some dominoes slipping accidentally out of a technician's pocket could serve as the reason why a pair failed to take off.

This is how it happened. An order came from the CP for two interceptors to take off. A pair of fighters were getting ready to take off. The pilots were taking their places in the cockpits and the technicians were helping to start the engines. Before closing the canopy, officer V. I. Dement'yev leaned over into the cockpit, and from the pocket of his jacket fell the dominoes. The sortie was aborted.

Indeed, it is not permissible to release an aircraft for flight without ascertaining whether some of the dominoes had not fallen under the pilot's seat where the control rods pass. And the decision to ground the aircraft was correct. The episode involving officer Dement'yev during the tactical flight exercises was vexing.

But all this would have been a thing of the past if only... but let us tell the whole story.

After the return of a dual from a weather reconnaissance mission the commander announced at formation that the flights would be carried out in accordance with the complex variant of the table. The meteorologist reported on the weather: altitude of the cloud base — 600 m and of the cloud deck — 7000 m; the wind was NW at 6-8 m/sec.

The airmen dispersed in order to get ready for the flight. The airfield was filled with the usual noise of a flying day.

Military pilot Maj. I. M. Lobzukov requested permission to start the engines, and a few minutes after takeoff clearance the silvery plane, marked with the number 43, was penetrating the clouds. The entire attention of the pilot was concentrated on the instruments. His eyes watched their readings in the accustomed sequence: gyrohorizon-speed-gyrohorizon-course.

The plane sank, so to speak, into the darkness. The gray mass of clouds enveloped the glass of the canopy, the wing tips were hidden in the impenetrable darkness. But a short while later the bright rays of the sun filled all the surrounding space, the white wavey clouds remained below. The momentary tension subsided, there was a sense of joy and calm. The altimeter read 8000 m.

And suddenly the flight controller heard the calm but unusual report from Maj. Lobzukov:

"I've penetrated the clouds. Fuel pressure zero, the tachometer needle is swinging between plus and minus 500 rpm."

The flight had to be terminated.

This became known not only to the flight controller but also to the pilots who were at the CP. The news upset especially Capt. Ya. G. Tuzov, since part of the blame for the incident was his. Several flying days ago, after a new engine was installed, he tested the aircraft in flight. At that time the pilot did not attach any importance to the fact that the fuel pressure dropped abruptly at a higher altitude. He did not even tell the plane's technician about it. And this was the result...

Flight accidents and their causes occur as the result of all sorts of negligence, poorly organized checkout of work performed, as well as insufficient training on the part of the flight and technical personnel.

It happens that we often seek the reason for some of the causes for flight accidents in some particular and unusual occurrences, in gross violations of operation and maintenance rules, without paying attention to individual cases of negligence and carelessness in work. It is thus that the case of Dement'yev's dropping the dominoes from his pocket was viewed as an accident and not as a gross violation or negligence. But if one ponders over the consequences of this event it becomes clear that such a seemingly trifling incident resulted in a mission abort.

Officer Dement'yev did not draw any conclusions from this incident. He again showed carelessness in his work. When an engine was being replaced in a plane he did not organize any efficient checkout of the work performed, and when the power plant was tested, violating the requirements of instructions, he did not check the reading of engine operation control instruments at idling regime. As a result, the wrong connection between the P-100 transmitter connection and the main fuel line was not discovered at the proper time.

What else is this but carelessness?

The above example not only testifies to the laxity of control over the quality of installation work, but also reveals the shortcomings in the organization of training for the flying and technical personnel, as well as a careless attitude towards the program for flight testing the aircraft which come out of TECh [technical maintenance unit]. And yet nothing must be neglected in our work. Everything is important here, everything deserves special attention. Whether you are flight testing an aircraft, replacing an engine, or locking a nut, installing a block, or driving in a screw -- no matter what you are doing, be conscious of it, think about the quality and the consequences of your work, because all this, in the final analysis, influences the outcome of a mission.

A constant display of care in improving the quality of training, and further improvement of technical knowledge on the part of the flying, engineering and technical personnel are the service duties of every engineer. Nevertheless, not enough attention was devoted to this in the unit where P. O. Osadchiy serves as an engineer. The training was conducted only in the form of lectures, and such other forms as practical training on the aircraft was not employed regularly. The planned subject matter in many cases did not correspond to the problems which were being studied during the given period of training.

It should be pointed out that a thorough study and analysis of causes of flight accidents in one's own unit as well as in other units prevents accidents to a considerable extent. This increases vigilance on the part of the soldiers, improves their technical knowledge, and enriches their experience in servicing aircraft.

Technical critiques play an important part in the fight against causes of flight accidents. At the critiques the day-by-day practical experience of the air unit is discussed in detail. This is why the critiques must be held, as a rule, regularly after each flying day or night.

Many of our engineers include in the plan of technical critiques such items as analyzing cases of incompetent operation and maintenance of aircraft, passing out information on defects which were found, together with an explanation of what caused them, and instruction in the methods of preventing them directly on the aircraft. Advanced methods of organizing aircraft servicing are discussed here.

During a discussion of special problems a critique conducted with a group of technical personnel of various specialities is very useful. This makes it possible to study theory more intensively and to develop and to work out ways of eliminating the defects.

Nevertheless, training sessions and technical critiques with all the specialists of the engineering aviation service participating is but one aspect of the matter. The other aspect, which is no less important, is independant study on the part of technicians and mechanics.

In addition to technical critiques we use also many other forms of disseminating technical knowledge and advanced work methods. Thus, for instance, in the unit where Engineer Lt. Col. I. S. Mamet serves as IAS [engineering aviation service] deputy commander, seminars for element technicians are organized and the local radio station is used to present the outstanding men; the wall-press and flash bulletins are made use of. All this benefits greatly the pilots and technicians, but especially the young aviation specialists.

Facts prove how important it is to treat the inspection of units and components in the spirit of scientific research, letting no single trifle escape scrutiny. That is exactly how Communist Mamet teaches his subordinates. It is not by chance, therefore, that the personnel of this unit discovered in good time, on certain aircraft, cracks in the crosspiece of the fourth frame and in the gas turbine blades, as well as mercaptide deposits in the low-pressure fuel filters.

The Party and Komsomol organizations always come to the aid of the commander. Thus, on the initiative of the Komsomol members, competitions were initiated in the unit: for raising the level of technical know-how, for the best work station, and for the most careful tool maintenance. As a result, the quality of technical servicing of aircraft improved, and causes for flight accidents, for which the engineering and technical personnel were responsible, were eliminated.

How well the technical personnel will be trained and indoctrinated now greatly depends on the engineer. His immediate assistants in this work are the element technicians and the chiefs of the service groups.

This is why an engineer must foster in them a profound sense of military obligation for preflight servicing of aircraft, as well as attentiveness and a feeling of responsibility. Indeed attentiveness and professional keenness of observation are not innate qualities of specialists. These qualities are developed in the course of

everyday painstaking training and with a creative approach in carrying out every task. Only such an approach to aircraft operation and maintenance will make it possible to eliminate occurrences like the one in the case of officer V. I. Dement'yev and to prevent their appearance; in a word, to do everything possible in order that any mission be carried out without delays or aborts.

PRACTICAL AERODYNAMICS FOR THE PILOT

8. Landing of a Supersonic Aircraft with Power Off

Col. S. A. MIKOYAN, Test Pilot First Class;
Engineer Lt. Col. S. V. PETROV, Test Pilot First Class

Some pilots, and this particularly applies to young pilots who recently joined the Air Force, sometimes express a doubt as to the possibility of landing a supersonic aircraft with power off. At first glance such doubts may seem to be justified. After all, when gliding with a throttled-down engine or with power off we have a high vertical speed and a steep trajectory, these factors being determined by the aerodynamic characteristics of modern aircraft.

However, judging from our experience and that of other pilots who have had to intentionally or unintentionally land an aircraft with a throttled-down engine or with power off, we believe that such a landing is entirely possible.

In this article we shall show a landing method which does not make use of engine thrust.

It is known that in choosing aerodynamic forms for a supersonic aircraft, the designer tries mainly to obtain favorable characteristics in the most "difficult" range of speeds, namely in the transonic region, as well as to have a high maximum speed. One of the most effective means of improving aircraft characteristics in the transonic speed region is to decrease the wing's aspect ratio. The aspect ratio, as is known, is the ratio of the wing's span to its median chord $\left(\frac{l}{b_{med}}\right)$. Ordinarily the aspect ratio is determined by the equation

$$\lambda = \frac{l}{b_{med}} = \frac{l \cdot l}{b_{med} \cdot l} = \frac{l^2}{S}.$$

Consequently, a sweptback wing has a lower aspect ratio than a straight wing of the same area. A characteristic property of supersonic aircraft is a comparatively low aspect ratio.

From a course in aerodynamics, it is known that when the thrust equals zero the aircraft is acted upon by the following three forces: the lift Y, the drag Q and the

weight of the aircraft G. Gliding of an aircraft can be considered a form of established motion. This means that the forces in a glide must be in equilibrium. From Fig. 1 it can be seen that

$$Y = G \cdot \sin\theta \quad \text{and} \quad Q = G \cdot \cos\theta.$$

From this it is easy to determine the tangent of the glide angle

$$\tan\theta = \frac{Q}{Y} = \frac{c_x}{c_y} = \frac{1}{K}.$$

Consequently, the glide angle depends on the aerodynamic quality of the aircraft, i.e., on the ratio of lift to drag.

The part of the wing drag which depends on the lift coefficient is called induced drag. The greater the coefficient of lift c_y and the smaller the wing's aspect ratio, the greater the induced drag. This can be seen from the equation for the coefficient of induced drag

$$c_{xi} = A \frac{c_y^2}{\lambda},$$

where A is the coefficient which takes into account the effect of wing shape in plan view on the downwash.

This is the reason why the induced and, consequently, the total drag on the wing of a low aspect ratio is greater than that on the conventional wing with the same value of c_y.

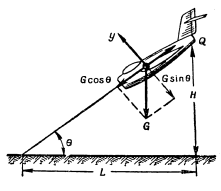


Fig. 1. Forces acting on a gliding aircraft.

Furthermore, the curve of c_y as a function of the angle of attack α exhibits a considerably flatter slope for a wing of low aspect ratio (see curve 2 in Fig. 2), which means that this wing must have a greater angle of attack α_2 than the conventional wing to provide the same lift coefficient. Flight at large angles of attack, however, increases the drag on the fuselage and consequently the overall drag on the aircraft Q.

For these reasons the aerodynamic quality $K = \frac{Y}{Q}$ of an aircraft with a wing of low aspect ratio is lower than that of an aircraft with the conventional wing shape, the lift being the same. The disparity in the quality is particularly great at comparatively high values of the coefficient c_y, corresponding to the gliding regime.

Maximum aircraft quality is achieved at low speeds close to the second regime. However, a reserve of speed is required to round out for landing which means that gliding must be done at a higher speed and, consequently, with a lower quality.

Knowing the quality, it is easy to calculate the gliding distance from a given altitude. As can be easily seen from Fig. 1, $L = \frac{H}{\tan\theta} = KH$, i.e., the gliding distance equals the product of quality and altitude. Let us take as an example an aircraft whose gliding quality at a trajectory speed of 420-450 km/hr is within the limits of 6-8 with retracted landing gear and 3-4 with the landing gear extended. In the latter case the aircraft will glide a distance of only 3-4 km from an altitude of 1000 m. The vertical speed in this case will be 15-20 m/sec and 30-35 m/sec with the landing gear extended.

While steep glide angles and high vertical speeds make the landing of modern fighters difficult without resorting to engine thrust, they do not however make the landing impossible.

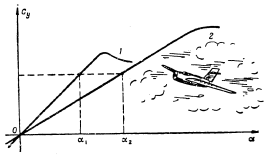


Fig. 2. Lift coefficient.

In carrying out such a landing two basic factors must be considered: the landing procedure and the roundout for landing.

Let us first consider the technique of gliding and landing.

The choice of the gliding speed is very important. From the point of view of maximum glide distance and minimum vertical speed, gliding should be attempted at a speed which corresponds to maximum quality. However, the minimum permissible gliding speed is determined first of all by conditions of roundout for landing.

At too low a glide speed, the possibility is not excluded that in the process of rounding out the aircraft may assume critical angles of attack which will result in ballooning and the aircraft may strike the ground roughly; it is also possible that stabilizer effectiveness will be insufficient to round out the aircraft. Furthermore, it is possible when gliding at a low speed to let the aircraft get into the second regime (i.e., to further decrease the speed) and in this case rounding out will be entirely out of the question.

Because of the steep glide angle and the high vertical speed in a power-off landing, the roundout is particularly complicated. This is why a reserve of speed is required, i.e., gliding should be done at a speed higher than usual. This fact further increases the glide angle and the rate of descent.

In modern aircraft, a loss of speed in gliding cannot be permitted at all. While the speed with low-speed aircraft could be increased easily in the past by moving the stick forward, a very great loss of altitude is required in modern aircraft before trajectory speed will show a sufficient increase. Therefore, loss of this down to a value which corresponds to transition to the second regime in gliding at an altitude of less than 1000-1500 m with power off can be an irreparable mistake.

However, the fact must also be remembered that an excessive increase in trajectory speed leads to a sharp decrease of quality and, consequently, cuts down the gliding distance. With an increase in gliding speed of 50 km/hr above the recommended value, the vertical rate of descent increases twofold. Rapid descent and sharp gliding angles complicate the roundout as well as the landing procedure, since the aircraft will overshoot a great distance after roundout.

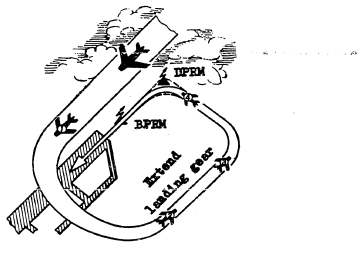


Fig. 3. Diagram of landing approach by the method of check points.

In supersonic fighter aircraft the speed should be maintained 100 km/hr above the glide speed given in instructions when coming in for a landing with power off. For more modern aircraft this speed should be increased by 130-150 km/hr. The speed given must be maintained up to the commencement of roundout, permitting in no case its premature reduction.

Even at the glide speed recommended by us the aircraft with power off will have a steep glide angle and high vertical speed. At high vertical rates of descent it is difficult to judge the point at which roundout should be begun and the tempo at which the stick should be pulled back.

To facilitate roundout we suggest that a method be used which we call "double roundout". As the term implies, rounding out is divided into two parts in this case. At first the pilot begins to decrease the glide angle at an altitude of 120-150 meters and brings the glide to the normal angle at which he ordinarily lands. Subsequently he continues to descend, maintaining this angle.

The second part of rounding out is done exactly in the same way as in normal landing and the technique of flying is no different from the usual roundout. It is clear that, following the first roundout, the trajectory speed begins to drop. However, if the above-recommended glide speed is maintained up to the altitude of commencement of the first roundout, the speed will be sufficient for normal landing at the moment of nearing the ground. The vertical speed after the first roundout decreases to 8-10 m/sec.

Let us now turn our attention to the landing procedure. Setting up the landing procedure and the glide path evaluation by eye alone is very difficult. The fact is that because of large angles of attack the aircraft's nose is directed far forward during the glide and descent proceeds along a steep trajectory. The landing, as a rule, is made with a short, which is discovered only at low altitude. When the pilot finally realizes that he will not be able to reach the airfield it is usually too late; he has no means at his disposal to correct the procedure.

However, if the glide path is estimated beforehand, characteristic points on the trajectory of the landing approach route are chosen, and the required flight altitude over these points is known, the procedure is considerably simplified and can be carried out with a sufficient degree of accuracy by a pilot of average qualifications (let us at this point stipulate that the procedure for power off is feasible only in good weather at an altitude of cloud cover of not less than 3000-4000 m). Such a method of estimating has been given the name of the method of check points. It is carried out in the following manner.

First of all, we come out at the point at which the landing strip begins on a course close to the landing course and from this point we begin a 180° turn, i. e., we carry out continuously the first and second turns. We set up our route in such a way as to be as close as possible to the landing point. The aircraft flies a very small circle, which is tangent to the beginning of the runway. Such an approach is unfamiliar to pilots who usually make the landing approach, as it is said, "at rpm's".

The four check points are also chosen with account being taken of such a route: the first is the beginning of the runway; the second the transverse of the beginning of the runway following the 180° turn; the third is the beginning of the third turn; and the fourth is the beginning of the fourth turn (Fig. 3).

It is desirable that these points be tied in with characteristic landmarks on the terrain. The second point is an auxiliary point by which extension of the landing gear is determined. It must be mentioned that after the extension of the landing gear, the glide path changes radically. It is practically impossible to make a visual estimate of the change of the glide path beforehand. The pilot must change over to a glide path with the landing gear down as soon as possible while the possibility still exists of correcting the landing procedure by setting up the route. In order to forestall premature extension of the landing gear we also make use of the check-point method. We extend the landing gear only when flight altitude over the check point is equal to or greater than the assigned value. If it is less than the assigned value the landing gear is not extended until the next check point is reached.

The altitude over the check points is in practice determined in flight for each type of aircraft. The altitudes may differ somewhat, depending on the manner in which individual pilots make the landing approach. The following altitudes can be quoted as a guide: 4000 m, 3000 m, 2000-2300 m, 1300-1500 m respectively over

check points 1, 2, 3 and 4 (see Fig. 3). The pilot glides towards the airfield in such a way as to come out over the beginning of the runway on a landing course at an altitude of 4000 m or somewhat higher. At this point he begins a turn of 180° with a bank of 30-40°. After completion of the turn, the distance from the runway will be 3-4 km. Completing the turn, the pilot considers the possibility of extending the landing gear. If, at the second check point, the altitude is 3000 m (or greater) he immediately extends the landing gear; if the altitude on the other hand is lower, he waits for the next check point. Passing over the third check point, i. e., somewhat before he reaches the DPRM [outer homing radio beacon] leg, the pilot begins a third turn in such a way as to move in a direction of the DPRM at an angle to the runway of somewhat less than 90°.

The fourth turn in this case is completed between the outer and the inner homing stations. Orientation in such a landing approach must be done visually instead of by the readings of the radio compass; in practice we mean here by the DPRM simply a point 4 km distant from the beginning of the runway.

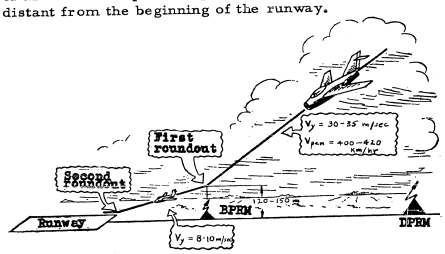


Fig. 4. Flight profile with double roundout.

In all cases a timely initiation of turns 1, 2, 3, and 4 makes it possible to correct the estimate. For instance, if the altitude over the first check point is greater than that calculated, the first turn is begun later when the difference in altitude will decrease by one half. In other words, if the altitude is 5000 meters the turn is begun at the moment when it has decreased to 4500 meters. We also introduce a correction into the beginning of the third turn if the altitude is greater than that calculated. However, if the aircraft reaches the altitude set for the commencement of the third turn earlier, the turn should be made immediately upon reaching this altitude. In all cases, after the third turn the nose of the aircraft is directed towards the DPRM.

If, at the moment of the fourth turn, the altitude exceeds the assigned value, the turn is begun later and is carried out with a somewhat greater bank. In case the calculated altitude is reached earlier, we immediately begin the turn and carry it out with a smaller bank; we make it shallower.

After the fourth turn we check the glide speed, since it might have increased. Experience has shown that no haste should be permitted in judging the procedure:

as a rule the first impression after the fourth turn has been completed is illusory; the pilot believes that he will clearly overshoot the landing. And only after gliding for a certain time and losing 200-300 m of altitude can one make a rather accurate judgement of the procedure. Complete confidence in the correctness of the procedure appears, as is shown by experience, at an altitude of 700-800 m.

The glide path prior to the commencement of the first roundout at the suggested speed must be directed to a point (see Fig. 4) approximately 800-900 m distant from the beginning of the runway. The procedure can be considered successful if the inner homing radio beacon is passed at an altitude of 120-150 m (provided that the recommended speed is maintained).

On the glide leg after the fourth turn there remains only one effective way at the disposal of the pilot for correcting the procedure, namely, the landing flaps (speed brakes can only be used in case their control system is in no way connected with the control system of the aircraft). However, the flaps cannot be extended until a complete certainty exists that the landing will result in a certain overshoot. The flaps should not be let down at a high altitude. Usually, when the procedure is correct, the flaps must be let down at an altitude of 100-150 m, i.e., immediately after passing the DPRM (they must be set immediately in landing position). In case the flap release system is connected in any manner with the aircraft's control system, the flaps are let down in the emergency fashion. If the pilot is not convinced that the landing will be accompanied by a certain overshoot, he does not let down the flaps until the moment roundout has been completed. However, after rounding out has been completed, we recommend that the flaps be let down in all cases, regardless of the procedure. In case of a short, the flaps can also prove useful when a little hit is required to hop over an obstacle (for instance, a fence or a road). In this case, it is possible to let down the flaps during leveling off and the aircraft, "ballooning", will fly for another few dozen meters, which may be just the amount necessary.

In extending the flaps to the landing position, the lift coefficient increases considerably with the same angle of attack (in Fig. 5, c_{y2} is greater than c_{y1}), which leads to an increase in lift, as a result of which the aircraft "balloons" somewhat

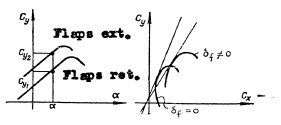


Fig. 5. By releasing wing flaps, lift coefficient increases while quality decreases.

at the moment when the flaps are let down. Furthermore, when the flaps have been let down after roundout, the touchdown will be delayed, since the landing speed will be lower. This follows from the equation

$$Y = c_y \cdot \frac{\rho V^2}{2} \cdot S;$$

with large c_y the required lift is obtained at a lower speed.

If an obvious over has been discovered while gliding after the fourth turn, the flaps must be let down — but hasty actions must be avoided.

As can be seen from Fig. 5, after the flaps are down the aircraft's aerodynamic quality decreases and, consequently, so does the gliding distance ($L_{gl} = K \cdot H$).

With a short, the aircraft is landed at wide angles of attack, the stick being pulled back to the limit of its travel. With an over, the aircraft is landed at smaller angles of attack, i.e., at a higher speed, but avoiding sharp motions of the stick; and, immediately following the touchdown, the wheels are braked lightly to prevent bouncing. In an emergency landing one should not hold the front wheel unnaturally off the ground. As it has been shown by experience, wheels are not damaged in a 3-point landing even at speeds of up to 400 km/hr.

In case of an emergency landing, immediately after the nose wheel has been extended, we fully depress the brake lever (with the brake booster on) and release the drag chute. Release of the drag chute is very effective in leveling off the aircraft just prior to touchdown (of course, whenever this is permitted by the instructions). The drag chute should under no circumstances be released at a speed greater than that permitted by the manual, since it can be torn off.

We have assumed in all of our previous discussions that the aircraft control system is functioning normally independently of the operation of the engine. But how should the pilot act if we assume that this is no longer true? We shall consider this question.

A booster control system is used in all modern aircraft with hydraulic amplifiers working in a non-reversible system. Mechanical linkage of the control stick with the aircraft's control surfaces is impossible in such cases. The pressure is created by a pump driven by the aircraft engine. In ordinary flight the pump has sufficient output at autorotation rpm of the engine. However, a decrease in flight speed in the roundout process during landing leads to a decrease in the number of autorotation rpm and, consequently, to a decrease in the pump output. On the other hand, roundout of the aircraft requires large deflections of the stabilizer and, consequently, a large expenditure of hydraulic fluid. For these eventualities and in case the engine is jammed, aircraft are usually equipped with an emergency control system which can be hydraulic or electric.

In an electric emergency control system, the rate of travel of the stabilizer is usually lower than that with hydraulic amplifiers in operation. If the emergency system does not provide for rate of travel of the stabilizer over 6-7° per second, landing with an inoperative engine on the emergency control system is very complicated and cannot be recommended. Landing is entirely possible at higher rates of travel, even though it requires a certain skill on the part of the pilot.

Let us note that with a correctly functioning control system and normal autorotation of the engine (in the absence of engine damage), the pressure is usually adequate up to the point of touchdown or at least up to the middle of leveling off (if gliding took place at a speed of not less than 400 km/hr). After completion of rounding out, landing on electrical controls even with reduced rate of travel presents no particular difficulties. In order to extend the period of operation of the main system before a switchover to the emergency system, we recommend that the hydraulic amplifier for the ailerons be switched off and the least possible amount of motion be done with the stick. To prevent ballooning or "bouncing" it

is necessary, if this is permitted by the instruction manual, that the drag chute be released at the moment of touchdown or just before the touchdown itself.

We must warn that in all cases of power-off landings, it is absolutely necessary that the operation of the emergency electrical system be checked beforehand at sufficient altitude and that the main system be switched on again. The landing profile must be held as much as possible in such a way as to make unnecessary the use of rapid motion of the stabilizer through large angles, i. e. the roundout should be gradual.

In order to gain experience in case a forced landing becomes necessary in the presence of engine break-down, systematic training is necessary, carrying out the landing procedures with an idling engine.

Practice landing runs with an idling engine are possible when the cloud cover is not below 4000-5000 m. The computation in the process of training must be begun at an altitude of 4000 m over the beginning of the runway on the landing course using the method described above. Of course, simulation of engine failure by throttling down is incomplete. Therefore, it is recommended that the entire approach be carried out with the speed brakes extended. However, the glide trajectory in such a case will be somewhat steeper than with a real engine breakdown. For complete simulation it would be necessary to glide with extended speed brakes and engine rpm somewhat increased. Since it is difficult to determine what rpm should be chosen, it is better to back off on the gas completely. The computation can be considered successful if the second roundout is completed ahead of the beginning of the runway.

Having made several landing approaches with an idling engine, pulling out into a second circle, and later with landing, the pilot will memorize the location of the check points, will find landmarks for their determination and will achieve a more accurate estimate of altitude.

With sufficient training the task can be made more difficult, throttling the engine at undetermined points with respect to the airfield, coming out directly at the second or third check points, as well as carrying out landing approaches with the aileron hydraulic amplifier in the off position.

In our opinion, it is advisable to include the landing procedure with idling engine as one of the elements in the examination of flying skills in an aircraft with duplicate controls, just as it is practiced in our unit.

We believe that every pilot must be able to carry out a landing with an inoperative engine. Definite training is required for this purpose. Systematic landings and their simulation with an idling engine make it possible to obtain the necessary experience and develop confidence in the pilot in the possibility of landing in case of engine breakdown.

ENGINEERING - KNOWLEDGE FOR INSTRUCTOR-PILOTS

THE ACADEMIC COUNCIL OF A COLLEGE ADOPTS A RESOLUTION

A regular meeting of the academic council of the Kachinsk A. F. Myasnikov Red Banner Higher Military Aviation College For Pilots was devoted to the organization of an evening engineering-technical university.

This matter did not come up by chance. The college trains cadres with a higher education. New tasks have confronted its teachers and instructor pilots. And for successful resolution of them, more profound engineering knowledge is required. The Communists talked about this at Party meetings. They all arrived at the unanimous opinion that it is necessary to set up in the flight training section an evening engineering-technical university for instructor pilots, teachers, and technicians.

In his report to the council, officer P. T. Putilin told about the curriculum of the evening engineering-technical university, the draft of the program for special and general educational subjects, and the specific suggestions worked out by a conference of heads of lecture series and departments.

In this, consideration was given to the experience of organizing such universities in line units. Of course, the specifics of the work of the college required appropriate changes in the programs by which the experimental evening engineering-technical universities of line units work: the number of hours for mathematics was increased to 74, chemistry was introduced. Lessons will not be conducted year round but only from November to March. Teachers who do not have a higher education will also study in the university.

The members of the academic council actively discussed how best to organize the evening university. In his address, officer I. B. Sorkin pointed out that this idea came from the lower ranks. The pilots, teachers, and technicians themselves became interested in obtaining the necessary minimum of engineering knowledge.

"In the evening university," declared engineer Col. G. M. Shul'man, "the officer acquires knowledge that will help him in his work and also in independent study of technical literature."

The following question arose at the council: what rights does a certificate of completion of the evening university give an officer?

"In this case it is a matter of a public measure which has as its basic purpose giving instructor pilots the opportunity to increase their knowledge," replied I. A. Gerasimenko, "and this will help them to teach the cadets better."

Summing up the results of the academic council's work, officer A. P. Titov announced that the members of the council unanimously resolved to set up an evening engineering-technical university on the basis of the flight training section.

Thus, the Kachinsk college is the first among the educational institutions of the Air Force to start an evening engineering-technical university for instructor pilots, teachers, and technicians.

The lessons begin with a study of the program of the preparatory course. In the course of 2.5 months the students review mathematics, physics, and chemistry at the level of the secondary school 10th grade. In the summer the officers will study independently, preparing for lessons in the first course, which will begin in the fall of 1960.

The university is taking its first steps. Some things in it will inevitably change, will improve as experience is accumulated and the desires of the students are taken into account. Of course, difficulties will be encountered in the work of the university at first. It needs help. For example, at the academic council there was talk to the effect that it is necessary to include the lesson hours of the teachers in general educational subjects in their teaching load, to legalize the organizational structure of the university. It is possible that precisely on the basis of its experience new forms of evening and correspondence teaching by the permanent personnel of the aviation colleges will be developed. But that which has already been done elicits the approval of the instructor pilots. The university gives them the opportunity to study with the help of experienced teachers general educational and special subjects, a knowledge of which is necessary for successful performance of the tasks confronting the college.

WORKING WITH THE AUTOMATIC FUEL SYSTEM IN FLIGHT

Engineer Maj. A. M. SHVAREV

Modern heavy aircraft are equipped with electric capacitance fuel meters which make it possible to check the amount of fuel in all the groups of tanks and automatically control its consumption without upsetting aircraft trim. Such automatic devices facilitate the work of a crew and increase flight safety. However, the role of the crew in controlling the fuel system does not diminish with installation of automatic devices. Any automatic device will operate reliably if it has been adequately checked before flight and is competently operated in the air.

And here we want to tell of a few characteristic cases which the crew may encounter in flight. In this we will attempt to give the pilots certain recommendations.

Let us start with the first part of a flight when, although there still is a considerable supply of fuel in the tanks, the 30-minute reserve warning light sometimes goes on. In such a situation the crew often considers that there is a leakage of fuel from the aircraft. As a result, they may make a hasty decision which is often incorrect.

But how must one act?

When the warning light goes on it is necessary without fail to check on the fuel gauge the amount of fuel present in the 4th groups. If the quantity corresponds to the full capacity of these groups, then there is no fuel leakage; only the operation of an individual warning light of the 30-minute reserve has been upset.

However, it may also so happen that the quantity of fuel in one of the 4th groups corresponds to the level for actuating the warning light, and in this the fuel decreases slowly. Then it is necessary to check the remaining groups of the engine. Having made sure that the total fuel reserve of all the groups of this engine corresponds to the readings of the fuel flow meters of both engines, it is possible to consider that there is no leakage. The reason for incorrect warning lies in the fact that the pump of the 4th group operates at a nominal regime instead of a reduced one.

The disturbance in the operating regime may be caused by a break in one of the field coils of the electric motor of the pump or a faulty contact in the relay of regime changeover (9) (Fig. 1). In this case it is necessary to switch to manual control of the pumps and simultaneously cut in the pumps of the two groups. Then the fuel will be consumed under the action of those pumps which operate at a forced

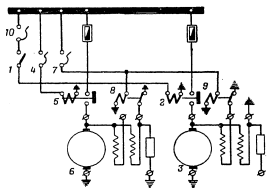


Fig. 1. Pump switching diagram:

1- switch; 2, 5- contactors; 3, 6- pump electric motors; 4, 7, 10- AZS [automatic circuit protection]; 8, 9- relay for changing operating regimes.

regime, and the pumps of the 4th groups, regardless of the fact that one of them operates at a nominal regime, will play the role of stand-by pumps.

However, something similar may happen to a crew which ignores checking the work regimes of the pumps by the readings of the manometer. It is not difficult to see from the diagram given in Fig. 2 that the warning system of the 30- and 15-minute fuel reserve reflects the actual condition when the fuel is consumed in a prescribed sequence. To actuate the warning system, it is sufficient that the quantity of fuel in one of the two fourth or fifth groups correspond to the level of actuation of the warning light, regardless of the fuel amount in the remaining groups.

The following also is important. The blue warning light went on, but the pumps of the next group did not start operating and this remained unnoticed. I may be told that the crew is not in a position to watch constantly the fuel feed panel, inasmuch as the moments of cutting in the pumps of the next groups are different and depend on the amount of fuel pumped into the aircraft, the work regime of the engines, and the flight altitude and speed.

This is really so. However, it is possible to determine the moment of cutting in the pumps if the operation of the automatic fuel system is known well. The fact is that if the pumps of the next group do not cut in, then after the fuel reserve of the preceding groups has been used up, it is consumed only from the 4th and then from the 5th groups by gravity. In this case two pumps will work at a nominal and two at a reduced regime. They pump air into the main fuel line (filled with fuel flowing by gravity). Air "plugs" will be formed in the system, as a result of which the engines will operate unstably and may even shut off.

Why then are the regular booster pumps not switched on?

Most often this happens due to an absence of contact in the relay switching the pump control from manual to automatic (Fig. 2).

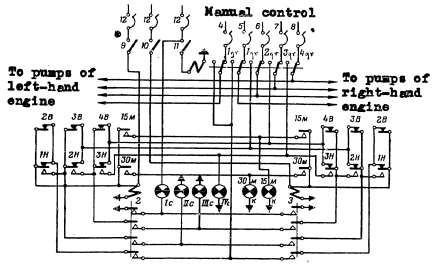


Fig. 2. Diagram of direct current circuits of the automatic fuel flow meters.

In order to forestall the possibility of unstable operation of the engines, it is necessary to determine the moments of cutting in the next groups of pumps before each flight. Knowing the moments, the crew may check the operation of the automatic devices in proper time.

The cutting-in moments of the pumps are determined with the aid of an engineering and navigational flight graph with a plotted fuel reserve curve on it, computed with consideration of all the factors affecting fuel consumption.

It is known that the induction warning lights start operating at definite fixed levels of fuel in the tanks. Marks corresponding to them are introduced on the axis of the coordinates and the amount of fuel is read off on the axis.

Given in Fig. 3 are two curves of fuel reserve for flights on various missions. The determination of the moments of cutting in the next groups is shown graphically. It is seen from the axis how much they may differ for various flight missions.

Starting on a flight and knowing the time of cutting in the next pumps, the crew will always be able to notice in time a disturbance in the operation of the automatic devices and take correct action—switch to manual control. If, however, a failure has occurred when cutting in the pumps of the 2nd groups, then, after the fuel has been used up from them, it is expedient to switch to manual control.

There was the following case. Once a pilot, being in a hurry, did not switch on the stand-by pumps before flight and did not check the operation of the automatic devices in flight. After the fuel was used up in the 1st, 2nd, and 3rd groups of tanks, interruptions in the operation of both engines were noticed and one of them soon shut off. Failing to examine the cause of the situation, the pilot switched to manual control, cut in the pumps of all the groups, without paying attention to the switch of the stand-by group.

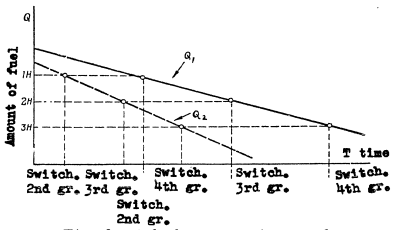


Fig. 3. A fuel consumption graph.

After the fuel of the first 3rd groups of tanks was used up, the pumps of the 3rd groups began operating at a forced regime. However, the pumps of the 4th and 5th groups did not start operating. The fuel began entering by gravity and the pumps of the 3rd groups pumped air into the main line, creating air "plugs" in it.

When the pilot switched to manual control and cut in the pumps of all the empty tanks, he thus increased the air dose fed into the main line, which worsened the condition of engine operation even more. The switch of the stand-by pumps remained switched off.

And only owing to the fact that the aircraft was at a short distance from the airfield could the pilot land it normally with one engine running unstably.

Let us analyze still another characteristic case. At the beginning of a flight, when the fuel is used up from the 1st groups of tanks, the green light of the warning system of pump operation of the 4th right-hand group goes out. Having checked the bulb, an inexperienced pilot may think that the pump has failed. After making sure that, even without taking into account the refueling of the 4th right-hand group, there is enough fuel to carry out the mission, he decides to continue the flight.

Such a decision, however, is sometimes premature. Let us refer to the diagram in Fig. 4. After all, the pump may be cut out either because of a fuse burnout or a failure of the switch-over contactor (4).

In the latter case the pumps of the 2nd, 3rd, 4th and 5th right-hand groups will not operate. If this is not determined in good time the crew may find itself in a difficult situation.

Correct actions are taken by those pilots who always check, when the warning light of one of the pumps goes out, the operation of the remaining pumps by manual control. According to the combination of the inoperative pumps they find out what happened: whether the failure is due to the group fuse or the switch-over contactor.

When the contactor fails, one of the generators should be cut into the emergency circuit, and the rest left in the normal position. In this both the circuits will be under voltage and the operation of the pumps will be resumed.

Once a pilot in flight noted with satisfaction that the pumps of the 2nd groups cut in on time. But what was this? Hardly five minutes had gone by when the pumps of the 3rd groups went into operation.

Switching on the left-hand and the right-hand automatic fuel flow devices by turns, the pilot established that there was a disturbance in the functioning of the automatic system of the right-hand engine and discovered fuel leakage by the fuel flow meter. Then the pilot shut off the fire valve, and switched off the right-hand engine and the right-hand automatic fuel flow device. The operation of the automatic system was resumed and the flight was continued on one engine.

After the fire valve was shut, the leakage of fuel from the groups of the right-hand engine stopped. Having opened the shut-off valve and after using up the fuel from all the groups for the single left-hand engine, the crew continued to fly on to their home airfield. In this case the airtightness behind the fire valve was disrupted.

This example bespeaks competent actions on the part of the pilot. Yet it might have been otherwise. If a rapid changeover of pumps is not noticed on time, it is possible to allow fuel drainage from all the tank groups of the right-hand engine, and, after thoughtlessly opening the shut-off valve, from the groups of the left-hand engine, as well. Then a forced landing of the aircraft outside the airfield is unavoidable.

It also happens as follows. The green lights of the warning system of pump operation of one of the engines go out. In checking the pumps by manual control, the pilot establishes that none of the green warning lights of this engine go on. What to do?

A knowledge of the diagram of the automatic fuel system enables the pilot to draw a correct conclusion. If there is fuel in the tanks, such a phenomenon is possible only during a failure in the warning system circuit. Making sure that the automatic protection device "cuts out", the crew may continue the flight, controlling the operation of the pumps by the fuel meter.

One should not lose one's head and make hasty decisions when an unusual phenomenon occurs in flight with the automatic fuel system in operation: the pumps of consecutive groups cut in at the proper time, while the pumps of the groups which used up the fuel do not cut out, and more than the prescribed number of green bulbs are lit on the fuel supply panel.

In this case, too, only firm knowledge of one's aircraft will be of assistance. The phenomenon described by us may occur only in a case when both automatic fuel flow devices are cut in, but one of them does not receive alternating current. An alternate cutting out of the automatic fuel flow devices makes it possible to find out in which circuit the fuse has burned out. After its replacement, the operation of the automatic fuel flow system will be resumed.

Let us explain this in somewhat greater detail (Fig. 2). We will assume that the fuse of the left-hand automatic fuel flow device has failed. When the toggle switches (9), (10), (11) and the AZS (12) are cut in, the relays (1), (2), and (3) beg in operating.

If the position of the relay contacts of the right-hand automatic fuel flow device corresponds to a definite amount of fuel in the tanks, the position of the contacts of the left-hand one corresponds to a fully topped aircraft. When using up the fuel from the 3rd groups, the pumps of the 1st and 2nd groups must be cut out, but they continue operating.

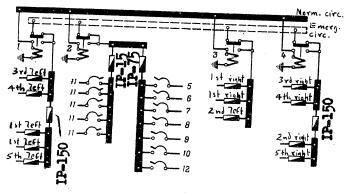


Fig. 4. A diagram of feeding the fuel automatic system with direct current:

1, 2, 3, 4- switching-over contacts; 5- right-hand automatic fuel flow device; 6- left-hand automatic fuel flow device; 7- fuel flow control; 8- warning system of the left-hand engine pumps; 9- warning system of the right-hand engine pumps; 10, 12- control of the stand-by pumps of the fourth and fifth groups; 11- manual control of the pumps.

The warning lights for their cutting in come from the contacts of the warning devices 1N and 2V (for the 1st groups) and from the green warning light P, through the contacts 2N and 3V (for the 2nd groups) of the left-hand automatic fuel flow device.

When a new fuse is burned out after the replacement of a blown-out fuse, or the operation of the automatic system is not resumed, this automatic fuel flow device must be switched off and the flight continued with one automatic device, control over its operation being increased.

In order that the crew can at any time determine a disturbance in the automatic system's operation and make a correct decision, it is necessary to conduct systematic training.

Constructed in our unit is a special trainer which makes it possible to practice many skills necessary both for the flight and engineering and technical personnel. Such a trainer makes it possible to simulate the consumption of fuel and the moments of switching over the groups of tanks according to the time with various quantities of fuel in the aircraft, the operation of the automatic system when refueling was incorrect, leakage of fuel from individual groups of tanks and from the fuel system of the aircraft as a whole, failures of group fuses and contacts in the electric circuit of an aircraft.

For convenience of transportation, the trainer is placed in two rather small cases (it can be easily carried by one person). It operates both from an A. C. electric circuit (~220v), and off direct current (=24 to 28v). The consumed power does not exceed 150 watts.

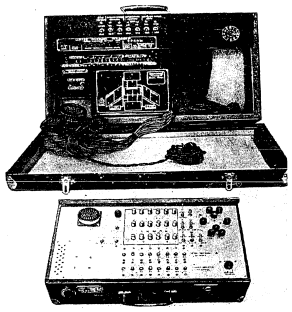


Fig. 5. Overall view of the trainer.

The external view of the trainer is shown in Fig. 5. Part of its set is a detailed diagram of the automatic fuel system, which helps to explain all the simulated failures and malfunctions.

How are the training exercises on the trainer conducted? For example, the crew is given the following problem: an aircraft returns from a mission, but, due to the situation, landing must be made on an auxiliary airfield. There is little fuel in the tanks. On the trainer panel a 15-minute fuel reserve warning light goes on. Your actions?

As in a real flight, the pilot must first of all switch to manual control and cut in the pumps of all the groups of tanks to use up the rest of the fuel.

The instructor may complicate the problem by simulating the cutting in of only the pumps of the 4th groups, the others being inoperative.

What to do?

A trained pilot knows that a simultaneous failure in the operation of all the pumps in a manual control may be only the consequence of burnout of the IP-15 fuse in the AZS circuit of manual control (Fig. 4). He gives a command to the navigator to remove the fuse from the sockets in the alternating current circuit of one of the automatic fuel flow devices, and he himself switches over to automatic control of the pumps.

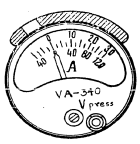
Systematic training exercises in the work with the automatic devices of the fuel system and detailed analyses of errors made by individual pilots in flight help the flight personnel to operate this complex apparatus competently.

GRAPHIC AND CONVENIENT

Checking the operation of a generator in the air by the readings of an instrument is not always convenient. In order to facilitate this operation we moved the volt-ammeter on the fighter aircraft to the right lower corner of the instrument panel where the starting fuel manometer previously was. Over the instrument on the instrument panel we made colored marks which facilitate orientation in the readings of the volt-ammeter while checking the operation of the generator (see figure).

On those aircraft which are supplied with special radiotechnical equipment, the V-46 type voltmeter is moved from the right fixed panel of the instrument board to the shock-absorber panel (to the upper right-hand corner).

Colored marks are made in the right section from "0" up to the end of the scale and on the left from division "20" up to the end of the scale with a red paint, and in the left section from "0" up to division "20" with white. If the instrument needle is located in the section painted white, this indicates normal operation of the generator. If, however, the needle has moved to the red section, the voltage of the aircraft circuit must be checked (and, consequently, the voltage of the generator as well) and conclusions drawn.



Marking off the instrument scale and systematic training exercises help the pilots to master firmly the rules of operating the aircraft sources of electric energy and to learn to act in special cases of flight.

Great help is rendered the flight personnel in studying and mastering the operation of the electric equipment of the aircraft, particularly the aircraft sources of electric energy, by our efficiency men. Thus, officer V. V. Frolov, who suggested changing the location of the volt-ammeter on the instrument board is working on an improvement in the warning circuit of generator failure on a combat aircraft and the engine starting circuit on a fighter trainer aircraft.

Officer O. A. Shaboltas suggested an improvement in the installation of electrical instruments on aircraft having a GSR-6000 generator, and worked out several working models for electrical equipment. Major of the Technical Service, N. V. Tulupov, personally made several stands for a detailed check of control devices under unit conditions.

These and a number of other suggestions and improvements of the efficiency men make it possible to operate the equipment competently, study all of its peculiarities and, by this, eliminate causes of flight accidents.

Guards Engineer Lt. Col. V. A. BERSHOV.

THANK YOU, PILOTS! THANK YOU, SEAMEN!

(A true story of the front line)

Col. B. G. GOFMAN,
Hero of the Soviet Union

In October 1943 our troops pushed into the sea the remnants of the routed units of the enemy's Taman' group and reached the shores of the Kerch' Strait. On the shore, the wheels cutting deep into the golden sands of the Chushka Spit, lay hundreds of abandoned motor vehicles, smashed cannon, and heaps of ammunition boxes.

Over the scarred Taman' soil, over the marshy lands and inlets fell an unaccustomed silence. In the distance, shrouded by bluish haze, loomed the outlines of the Crimean coast. There lurked the enemy, bristling with the cannon muzzles of coastal batteries.

After a few days our first amphibious landing force crossed the twenty-kilometer span of the strait and landed on the coast of the Kerch' Peninisula in the region of El'tigen village.

A fierce fight broke out. The Fascists exerted all their efforts in order to destroy the daring landing force. From morning to late evening, over the sheer Crimean coast, there rumbled an artillery cannonade, and there was the incessant drone of aircraft. Dozens of times the Hitlerites dashed into the attack, but the landing force did not falter; they withstood and firmly entrenched themselves on the captured beachhead. The Hitlerites decided to strangle them with a blockade. The foamy waves of the strait were plowed day and night by enemy torpedo boats. The provisions and ammunition supply line to the landing force were cut off. The situation became critical.

The landing area of the seamen occupied a strip of coastal land only 800 meters —1200 paces— in depth. It was difficult, very difficult for them. And then the pilots came to the rescue. It is true that the patch of liberated Crimean soil was so small that the loads paradropped by the transport aircraft drifted into the sea or towards the enemy. Therefore ground-attack aircraft were brought in to supply the landing force.

The 622nd ground-attack air regiment, which was commanded by Hero of the Soviet Union Lt. Col. I. A. Yemel'yanov, switched all its personnel to these rather unusual missions.

Every day from morning to evening work which was new to the ground-attack men was in full swing on the airfield. Instead of bombs and rockets, under the wings of the "flying tanks" were suspended parachute-equipped sacks with bread and canned food, with mines and shells, and with submachine guns and automatic rifles. With the accuracy of clockwork, at definite intervals of time, the overloaded aircraft rose into the air with an ear-splitting roar. At an altitude of ten or fifteen meters, they swept low over the hushed Cossack villages, over the inlets and marshy lands, and over the sheer Taman' coast, swooping beyond the gray waves of the strait, where they were awaited by the seamen with impatience and agitation.

Dozens of "Messerschmitts" launched fierce attacks many a time, striving to stop the ground-attack aircraft from reaching the Crimean coast. But the red-star-red fighters vigilantly guarded their brethren — the "air infantry".

At last, against the ground-attack aircraft which flew over the surface of the water at an altitude of the upper deck of a light cruiser, the Hitlerites decided to use field artillery. Several pilots, masters of ground attack, were surprised by huge columns of water lifted by the bursts of artillery shells which rose quite unexpectedly before the aircraft propellers. But the airlift from the Taman' coast to El'tigen village continued operating uninterruptedly. Up to five or six sorties were made daily by the pilots with loads for the "Land of Fire".

On one such flight a sextet of ground-attack aircraft was led by Squadron Commander Capt. Vladimir Opalev. I was his deputy. Flying in our group were Anatoliy Semenyuk, Yevgeniy Bogdanov, Pavel Arkhipov and Yevgeniy Myshko.

Weaving among the raging water spouts, skipping over the wave crests, we approached the target rapidly. The destroyed fishing settlement was already clearly visible. After a few seconds, smashed landing barges, trenches on the shore, and a few sailors' hats which were tossed up from the trenches in greeting flashed under us.

Having zoomed after the leader up to an altitude of 40 to 50 meters, we dropped the load at the assigned spot and suddenly distinguished on the ground, through a solid screen of flak, a multitude of gray "boxes" with black crosses on the turrets. Tanks — there were more than forty of them — were taking up initial positions for an attack within only a thousand meters from the landing force.

How and with what to help? After all, we had no ammunition. Captain Opalev led the squadron to our home airfield. After landing, we immediately ran to the command post. Excitedly Opalev hurriedly reported to the commander the situation on the beachhead.

Only six aircraft of our group stood on the airfield — the other squadrons had not yet returned from the mission.

"Load up with ammunition immediately! Take off when ready!" ordered Yemel'yanov and, turning to his deputy, Maj. Golubev, he added, "Mobilize all those who are on the airfield to suspend bombs!"

When we ran up to the aircraft, work was already in full swing. The mechanics, having learned what was up, exerted all their efforts in order to service the craft faster for takeoff.

The airfield looked like a disturbed anthill — everybody was working. And an incredible thing happened — something that is not provided for by any norms: after

eight minutes Capt. Opalev's aircraft lifted off the ground. Others flew up in his wake. And in another minute a sextet of ground-attack aircraft set their course in tight formation.

We came just in time. Some 400 to 500 meters divided a large group of enemy tanks from the strait. Our landing force rolled back to the smashed barges in short waves. They could be clearly seen from the air.

The lead plane went into attack in a straight run, the other five swooped behind him into a dive, pouring fire on the tanks and the Hitlerites who were advancing behind them.

After the first attack, having gained altitude, the ground-attack aircraft dashed into the second one. Three tanks were burning on the ground. A strip of gray AA bursts hung in the air.

After the third run, when there were already six tanks burning, enveloped in red tongues of flame, and the pilots saw the surviving tanks turn around and crawl slowly back, away from the fishing settlement. While they were crawling away into the hollows and covers we found time to attack them from the air another four times and two more enemy tanks remained burning on the battle field.

New groups of ground-attack aircraft appeared in the sky from the direction of Taman'.

"Assembly! Assembly!" The voice of the squadron commander was heard in the earphones, and a sextet of aircraft, coming out of attack, swooped low over the foxholes and trenches, over the solitary chimnies jutting here and there where not long ago the white shacks of the fishermen stood. We saw the men of the landing force run from the shore and jump into the trenches; they jumped out again and hurled themselves into a counterattack to finish off the Fascist submachine gunners.

The situation was saved. With a happy feeling of relief we, the "air infantry" were leaving the "Land of Fire" where as previously, the "naval infantry" was stationed.

Some eight or nine kilometers of foamy white waves divided the ground-attack aircraft from the Taman' coast when Lt. Yevgeniy Myshko informed the leader over the radio:

"The aircraft has been hit. The motor is faltering!"

The air was quiet and only the familiar crackle reminded us of the operating radio sets. The pilots' excited breathing was heard in the headset. Another two or three agonizing seconds of silence, and the soft and soothing voice of the commander broke the stillness:

"Myshko, come out forward, head for the coast! Others are to cover Myshko."

And although there were no "Messerschmitts" in the air, all five aircraft throttled down. The drone of the engines became subdued, speed gradually decreased and, passing the aircraft flying at minimum speed, the battered ground-attack aircraft of Myshko, losing altitude, pulled up ahead. A large hole, torn by an AA shell, gaped in his right wing. I could clearly see the waters of the strait through it. On the surface of the stabilizer, there bulged in a straight line four torn holes, made by a burst of machinegun fire. Flapping in the wind on the elevator was a piece of skin ripped off by a shell; a long stream of oil was trailing behind the aircraft, as though sprayed by an atomizer.

Lieutenant Myshko exerted incredible efforts in order to keep the craft from dropping, and in the beginning he managed to do so. The sheer coast of Taman'

was already distinctly visible and there, over the precipice, was a field as level as a table top. Often the pilots had to land on this field their damaged and battered aircraft. "A little more, still more, a couple of minutes yet!..." One wished to support the ground-attack aircraft of the comrade in the air with the wings of one's own craft.

Less than five kilometers remained to the coast - only one minute of flying. "Now just a little more" - whispered the pilots. But the engine already coughed up black exhaust. The propeller noticeably reduced rpm and suddenly stopped.

"Steady, Zhenya! Steady! Set it down on the water!" came the calm voice of the captain.

And the seemingly lifeless aircraft of Lt. Myshko leveled off now at the very surface of the water and, after a second, plowed the waves like a sea sled, throwing up huge fans of emerald spray.

"Landed classically!" somebody's enthusiastic cry broke the silence.

"In a circle! In a circle!" commanded the captain.

And five ground-attack aircraft circled like a merry-go-round over the aircraft which had touched down on the water. It was still gliding like a sea sled but its speed was dropping fast. Then we saw the pilot clamber out on the wing, followed by the aerial gunner.

"Why are they so slow?" thought each of us and — perhaps this was my imagination — I distinctly heard a sigh of relief in the earphones when both comrades jumped into the cold water and began swimming, supported by lifebelts.

The aircraft plowed on another fifty meters. Then, suddenly dipping its nose, it sharply lifted its tail toward the sky and vertically sank under the water. We flew in a circle and had no other means to help our comrades-in-arms.

Now a white bow-wave raced to the scene from the Taman' coast. While the five ground-attack aircraft were circling twice, the cutter managed to make almost half the distance from the shore to the pilots in distress.

And now we saw two more white bow-waves which were approaching fast from the direction of the Crimea. It was the enemy. Without hesitating a minute, Opalev led us across the Fascists' path.

Very little fuel was left in the tanks. But, fortunately, one run of the five planes was enough to set aflame the enemy cutter which, spouting flames, broke into pieces, while the other turned sharply and started withdrawing.

When Capt. Opalev led his group again to the Taman' coast, the seamen on the cutter were already taking our friends out of the water.

It is difficult to tell what each of us felt in those short minutes when we were approaching for a "straight-in" landing. So much happened during this one mission that it is simply impossible to tell at once which one of them was the main event: the lucky drop of a scheduled load on the "island", and the crash preparation for flight, or just this final episode. Everything was important, all was significant. But especially well remembered is how fast the naval cutter dashed to the rescue of our two comrades. And until now this picture stands before my eyes: a small dot, leaving behind it a silvery bow-wave, running headlong over the dark smooth surface.

A telegram awaited us at the airfield from the landing force. Lt. Col. Yemel'yanov read it off before the regimental formation. The telegram began with the words:

"Our thanks to the pilots..." And further on it confirmed the fact that the sextet of ground-attack aircraft of Capt. Opalev had destroyed eight enemy tanks and many Hitlerite soldiers. This helped the seamen — the landing force of the "Land of Fire" — to hold the beachhead on the coast of our native Crimea.

And when, after an hour, Lt. Myshko arrived at the airfield with his aerial gunner, on behalf of the pilots a telegram was sent to our combat friends, beginning with the words:

"Our thanks to the seamen..."

WITH A MESSAGE TO THE FIRST CAVALRY ARMY

It was June 1920. The Cavalry Army of S. M. Budennyy, having broken through the White Polish front, began its heroic raid on the enemy's rear lines. Entrusted to maintain liaison with the cavalry was the air group commanded by M. P. Stroyev.

It was a difficult mission: the majority of the aircraft had a small radius of operation; in addition, they were dilapidated and in disrepair. But the cavalry advanced far ahead.

The first drop message was delivered to the Red Cavalry men by pilot I. P. Kuznetsov. On the next day, 12 June, the commander of the 36th Air Detachment, experienced pilot S. F. Smirnov, took off on the mission. He came to the Southern front from the north where he had distinguished himself in battles against the English interventionists. Although Smirnov knew that his "Sopwith" was worn out, that the motor was "knocking", and the wheel rims held in place only because they were tied up with rope, he took off without hesitation to carry out the mission.

The package had to be received from the front commander. Having quickly serviced the aircraft, Smirnov took off for Kremenchug, together with air observer Lyakhovich. The staff car of the Revolutionary Military Council stood on the side track of the railroad station. Smirnov and Lyakhovich were led to the commander's compartment, the walls of which were covered with maps.

"You must fly over the White Polish Front , said the commander, "find our cavalry and hand this package personally to comrades Budennyy or Voroshilov. In the case of a forced landing the package must be destroyed."

The weather was fine. During the flight, checking with the map, Lyakhovich continuously tracked the flight route. The pilot and the observer attentively scanned the terrain, trying to spot the cavalry units and trains on the main and country roads. Suddenly they saw a long column of dust in the distance above the main road: a large cavalry column was moving to the west. But whose troops they were was impossible to determine from the air. Smirnov decided to take a risk: to land at the tail of the column and find out its exact identity. There was no other way out.

The aircraft landed. Several cavalrymen headed immediately toward it. Having turned the craft with the motor running into the wind and without leaving their cockpits, the pilots waited for the cavalrymen to approach. Lyakhovich pointed the machinegun at the riders, ready any moment to open fire. The riders were approaching fast.

"Friends!" — joyfully shouted Lyakhovich.

Military Pilot I. P. Kuznetsov

In the village hut where the headquarters was located S. M. Budennyy took over the package from Smirnov and opened it immediately. While the pilots were refreshing themselves with rusks and milk, reply messages were prepared. They flew back the same day and landed on their airfield in Potash.

Late in the evening the air commander of the Horse Cavalry Army, M. P. Stroyev, reported: "Our aircraft today found the field headquarters of the Army at Andrushevka and returned with packages. Report to the Army chief of staff that air liaison has been established." (TsGASA [Central State Archives of the Soviet Army], stock 245, inventory 3, file 301, sheet 10.)

In the subsequent days of June a few more flights were made to the field headquarters, while the whereabouts of the headquarters was unknown.

At times one had to fly in almost incessant rains, with low overcast, and in fog.

Bombs were usually carried on these flights. Once at the approaches to the town of Kazatin, Kuznetsov noticed a concentration of enemy troop trains. He turned around and flew over the railroad tracks congested with cars. Air observer Mitrofanov dropped two poods of bombs. The aircraft, relieved of its weight, quickly left behind it the station which was enveloped in fire and smoke. Soon the aircraft was rolling on the grass of the airfield near Zhitomir.

The enemy attempted to disrupt the flights for liaison with the Horse Cavalry Army by sending their aircraft to intercept our reconnaissance craft. Besides, our aircraft had many malfunctions and this complicated the execution of the missions. For example, pilot I. P. Kuznetsov reported after the flight that the aircraft engine was "rattling" and the front machine gun did not work.

However, soon after Kuznetsov was flying it again. In the rear cockpit, next to the "Lewis", his faithful combat friend, air observer I. D. Mitrofanov took his place. This was on 18 June. When only a few minutes remained to the end of the flight, Kuznetsov noticed, in the clear blue sky, a small dot — an aircraft which was approaching Zhitomir from the west. An encounter with the enemy at that moment was quite undesirable. But it was impossible to avoid it. In answer to Mitrofanov as to what to do, Kuznetsov replied: "We'll fight!"

The enemy "Bréguet-XIV" reconnaissance aircraft with a top speed of 190 km and armed with one front and two turret machine guns was much more powerful than a "de Havilland" with only one rear machine gun. And yet Kuznetsov courageously joined in an unequal air combat which lasted almost half an hour. But suddenly the "Lewis" became silent. Kuznetsov, seizing his opportunity, and making a tight turn, broke away from the enemy .

Military Pilot S. F. Smirnov

Soon afterwards, he safely landed the craft on the field near the railroad station and delivered the packages to their destination.

When the pilots began examining their aircraft, they counted more than 20 holes. In some places the bullets had pierced through the longeron and one of the struts of the wing center section: the aileron control cable was broken in two. It was necessary to repair the damages as fast as possible and take off. The pilots fastened the control elements with wire and flew back at dawn.

Attaching great significance to the Air Force in its joint operations with the cavalry, at the end of June S. M. Budennyy reported to the front commander: "For strengthening army aviation and assigning to it its proper importance, it is necessary to reinforce it with one more air detachment and provide it with several powerful new aircraft" (TsGASA, stock 102, inventory 3, file 777, sheet 102).

Pilots S. F. Smirnov and I. P. Kuznetsov and others, for bravery displayed in liaison missions to the field cavalry, were awarded orders.

This is only one of many pages in the glorious history of the young Soviet Air Force which took part in routing the enemy troops during the years of the Civil War.

B. N. ORLOV.

FROM THE EDITOR'S MAIL

The Reader Continues the Discussion

TRAINING ON THE YaK-18A IS QUITE POSSIBLE

Last year we received two Yak-18A aircraft with the rear cockpits equipped in the way suggested by Lt. Gen. of the Air Force V. V. Fokin in his article ("Herald of the Air Fleet", No. 1). The uniqueness of this idea lies in the fact that an insignificantly minor remodeling job produces great results. In a flight in the Yak-18A aircraft those instrument flight conditions in an enclosed cockpit are reproduced which hold for a MiG-type jet aircraft. This is attained due to the creation of complete resemblance in carrying out such flight elements as timed climbing turns and banked turns of 30 - 45°; angles of turnaway; time intervals after passing the DPRM [outer homing radio beacon] with a course opposite the landing course up to the procedure turn; the regime of horizontal flight, climbing, letdown (combat and training); the approach and the landing procedure with two 180° turns; engine rpm; landing and takeoff.

Our flights in the Yak-18A were carried out in accordance with an approved program. Preliminary preparations were carried out on general and ground training days and partly on non-flying days. The flights were organized also for cases when sorties in combat aircraft were cancelled. Flights were also made in the Yak-18A when another squadron was aloft in combat craft. In this case the Yak-18A aircraft were directed to two zones, positioned at 90° to the runway to the right and left (altitude in the zone 200-300 m). If there were no planes on the glide path and in the pattern, the OSP [instrument landing] system was used. Commanders of elements and higher-ranking officers were called in as instructors.

During these flights in the Yak-18A aircraft we practiced in the enclosed cockpit: the technique of flying on instruments in the zone, flights by the OSP system with the approach and straight-in landing procedure with two 180° turns, a route flight with retuning of the ARK-5 [automatic radio compass] to homing radio stations at neighboring airfields, the approach and landing procedure with the help of a radio direction finder, and flying the aircraft on supporting instruments with the AGI-1 [artificial horizon] switched off.

By flying on instruments in the enclosed cockpit of the Yak-18A aircraft, which differs from the UTI MiG-15 aircraft in that it requires greater precision in maintaining the regime, the pilots received some good training in prolonged instrument flights and firmly consolidated habits in distributing and switching their attention.

Experience has shown that in teaching and systematic training on this aircraft, it is possible to minimize the norms in logged instrument flying hours in an

enclosed cockpit in the UTI MiG-15 aircraft. Training flights on the Yak-18A may considerably reduce the number of errors in the technique of flying under adverse weather conditions and after interruptions in flying in jet aircraft.

Col. B. V. SHIKHOV,
Maj. G. D. KISHCHENKO,
Military Pilots First Class

WE SECOND THE SUGGESTION

Lieutenant Gen. V. V. Fokin made a very good suggestion in the first number of the magazine when he expressed the feeling that, along with exercises on the trainer, it is necessary to use the Yak-18A for instructing young flying personnel how to fly on instruments.

One of the virtues of the suggestion offered lies in the fact that the instruments in the rear cockpit are graduated like the instruments in the UTI MiG-15 aircraft. This allows us to maintain flight regimes which approximate the regimes of combat-training craft and combat craft.

Last year we began teaching how to fly under adverse weather conditions. In the process of carrying out the practice program of flying on instruments and under adverse weather conditions in the UTI MiG-15, it was suggested to us that we make parallel use of the Yak-18A for additional training purposes.

According to a previously elaborated plan, we practiced on the Yak-18A aircraft horizontal flight, 90 - 180° turns, the interception of given courses, getting out of a difficult situation, route flights using radiotechnical facilities, penetrating the clouds, and flying on supporting instruments when some of the flight instruments are switched off.

Having fully carried out these missions, each pilot logged an average of 8 - 9 hours, of which 7 - 8 hours were in an enclosed cockpit. The flights were carried out over a period of 15 days in three aircraft by the entire personnel of the squadron. They provided extensive training in maintaining and holding flight regimes in pattern cloud penetration, in the approach and landing procedure "with two 180° turns", and in piloting on supporting instruments. We gave special attention here to methods of correcting errors when approaching for a landing and when letting down on the landing course.

Flying on instruments along a route in the Yak-18A, we acquired good habits in prolonged aircraft flights on instruments, in retuning the ARK-5 on homing and radio broadcasting stations, and in determining the aircraft's position by requesting 2 - 3 radio bearings.

The GIK-1 [gyroinduction compass] pleased us very much. This instrument considerably facilitates the pilot's actions in correcting errors and in coming out on the right course.

Training pilots in the use of instruments in the Yak-18A aircraft thereafter showed good results in instrument flights in a combat training aircraft. The entire inexperienced flight personnel came to maintain more confidently given flight regimes.

On the basis of our experience we feel that flights in the Yak-18A should best of all be carried out on some day after flights in combat aircraft — providing that, in accordance with the unit plan, the latter flights are made every third day. The second day may be used for conducting full-scope preliminary preparations. Such a manner of organizing the work will not in the least lower the quality of reparation amongst the flight personnel.

It is not at all desirable to organize joint flights in Yak-18A aircraft and combat craft, since here the organization and conducting of such flights is greatly complicated.

Capt. M. V. KALNYSHEV,
Military Instructor-Pilot First Class;
Lieutenants N. I. SOKOLOV,
V. A. MALENEV, M. I. DROZD,
Military Pilots Third Class

THE STARTING CHARACTERISTICS OF THE TURBOSTARTER CAN BE IMPROVED

In the process of starting engines, especially for repeat sorties, there sometimes occurs a cold stall of the S-300-M turbostarter, since fuel combustion does not take place in the combustion chamber. Such a phenomenon is usually observed between 5000 and 6000 rpm. Normally, the engine cannot be started until after the starting system has been primed.

Having installed an additional push valve for draining the fuel, we have speeded up in our unit the priming of the turbostarter's fuel system.

However, this device, although it has lightened the work of the technical personnel, has not completely solved the problem. Usually the turbostarter stalls because, as a result of evaporation of the priming gasoline, a vapor-gas plug forms in the starter system.

We established that this is formed in an old starter system as well as in a new one. But an rpm stall is observed only in the latter (S-300-M).

Why is this?

It is well known that there are installed in a new starter system: a modified regulator, a second electromagnetic valve, and ball check valves in front of the starter nozzles. These design changes undoubtedly improve the operational reliability of the system. However, the starting characteristics of the turbostarter are somewhat worsened. Why? The specialists of our unit together with the operational faculty of the A. F. Mozhayskiy LKVVIA [Lenin Red-Banner Air Force Engineering Academy] did a great amount of work. In order to determine the reason for the deterioration in the starting characteristics, they installed on the S-300-75 starter a TNR-3R fuel regulating pump instead of the TNR-25 and a second electromagnetic valve. Artificially creating an air plug in various parts of the fuel system, they noticed that the starting characteristics of the turbostarter did not deteriorate here, since a natural bleed-off of the plug occurred through the open channels of the starter nozzles.

An air plug, created in the S-300 M's fuel system, especially in the sector between the electromagnetic valves, completely rules out turbostarter operation.

Its rotor only turns when the electric motor's rpm are up to 5000 - 6000.

Comparing the induction-pipe depression in this case with that which held true for the old system (S-300-75), we determined that it was almost 2 to 2.5 times less.

This made us think about the effect of the check valves installed in front of the nozzles of the turbostarter's starter igniters. The pressure required to actuate them is about two times less than on the basic working nozzle valves.

The conversion of the turbostarter's fuel system into a closed one led to the appearance of additional drag at the exhaust. The TNR-3R pump overcomes this drag only when it is flooded with fuel, i.e., when there is no gas-vapor or air plug.

The induction-pipe depression was reduced approximately 2.5 times, since resistance behind the pump increased and, consequently, the flow through the gaps in the pumping unit increased.

When we removed the ball check valves from the starter nozzles, the characteristics of the turbostarter became exactly the same as those in the S-300-75 assembly and they began starting very well. Thus we came to the conclusion that the turbostarter's starting characteristics deteriorated with the new fuel system because of the installation of check valves in front of the starter nozzles (i.e., because the fuel system at the exhaust was converted into a closed system).

The leaking of fuel, which will take place at cut-off after the termination of starting, is not dangerous, since the fuel ejected due to inertial forces immediately burns, although the process of combustion itself will be somewhat delayed. As regards the leaking or evaporation of fuel after the turbostarter has stopped, this — if there a second electromagnetic valve is installed which will stop the flow of fuel when the aircraft is parked — will be insignificantly small.

Thus, in order to improve the starting characteristics of the S-300M turbostarter, it is necessary in our opinion to remove the check valves installed in front of the starter nozzles. This job may be done by specialists of the unit, if they have the appropriate instructions.

Guards Engineer Capt. B. L. UREVICH

THE GRAPHIC SOLUTION OF PROBLEMS INVOLVING ULTRA-SHORT-WAVE SHADOWING

As the result of the practically rectilinear propagation of ultra-short waves (UKV) over the convexity of the terrestrial spheroid and variations in terrain elevation, "shadows" may be formed. We suggest the use of a graph, with the aid of which it is possible to determine graphically, quickly, and with an adequate amount of accuracy for all practical purposes, the regions of shadowing and thus find answers to problems connected with the use of UKV systems in broken or mountainous terrain (Fig. 1).

In Fig. 1 the heights are calculated from the level of the transmitter antenna (Δh; ΔH) (the diagram also shows the heights relative to the level of the transmitter antenna.

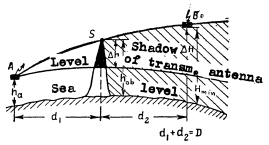


Fig. 1. Diagram of the formation of shadow areas during propagation of ultra-short waves over a broken terrain: A - transmitter (UKV); B - receiver (UKV); h_a - absolute height of transmitter antenna; h_{min} - absolute height of receiver; h_{ob} - absolute height of obstacle; Δh - height of obstacle relative to level h_a; ΔH - height of reciever relative to level h_a; d_1 - distance of obstacle from transmitter; $D=(d_1+d_2)$ - effective range of transmitter.

It may turn out that Δh and ΔH will have negative values. In this case one may use the lower set of curves (Fig. 2).

Let us deal with some examples. Let us have (example 1) the following initial data: h_a = 200 m; d_1 = 40 km; h_{ob} = 500 m; D = 175 km. We must find H_{min}.

We first compute Δh.

$$\Delta h = h_{ob} - h_a = 500\text{m} - 200\text{m} = 300\text{m}.$$

Using d_1 and Δh, we find point C on the graph. Moving to the right from it parallel to the range scale until we reach the vertical from the distance D = 175 km, we find point B, which gives ΔH = 3000 m. Hence

$$H_{min} = \Delta H + h_a = 3000\text{ m} + 200\text{ m} = 3200\text{ m}.$$

Let us solve the second example. Here the initial data are somewhat different*: h_a = 200 m; d_1 = 40 km; h_{ob} = 500 m; H_{min} = 3200 m.

We are required to find the effective range of the transmitter D. The problem is solved just like the first. We first find point C. Moving to the right from it to the value ΔH = 3000, we read D = 175 km along the vertical.

In the same way we may find one of the variables: H_{min}, D, d_1, h_{ob}.

The only problem requiring special solution is a problem involving h_a when it is necessary to determine the height at which the transmitter ensures normal reception at the height H_{min} (given).

Let us assume that: h_{ob} = 500 m; d_1 = 40 km; D = 175 km; H_{min} = 3200 m.

We are required to determine the absolute height of the transmitter antenna h_a at which, under the given relief conditions and ranges, reception is ensured at a height of 3200 m.

* For purposes of greater clarity, in all three examples one case is examined; in the initial data the value sought is merely interchanged with the given values.

In order to solve this problem (see Fig. 1), it is necessary to interchange the positions of the receiver and the transmitter; then the diagram for the solution remains the same, but the values become**:

$$\bar{h}_a = \bar{H}_{min};\ H_{min} = h_a;$$

$$\bar{d}_1 = d_2;\ \bar{\Delta}h = (h_{ob} - H_{min});\ \bar{H}_{min} = \bar{\Delta}H + \bar{h}_a.$$

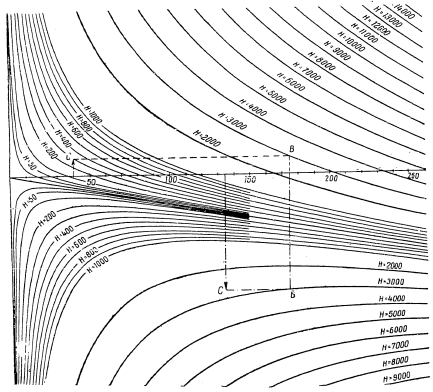


Fig. 2. Graph for determining variable values.

Going on to solve the problem, we compute $\bar{d}_1$, $\bar{\Delta}h$ and solve in the usual manner.

$$\bar{d}_1 = D - d_1 = (d_2) = 175 - 40 = 135\text{ km}.$$

$$\bar{\Delta}h = h_{ob} - H_{min} = 500 - 3200 = -2700\text{ m}.$$

** When the positions of the receiver and the transmitter are interchanged, new values are not introduced; they are merely noted above by a vinculum.

Using $\bar{d}_1$ and $\bar{\Delta}h$, we find point $\bar{C}$ and, using this point and D = 175 km, we determine point $\bar{B}$, which gives ΔH = -3000 (in Fig. 2 these points are without vincula).

$$\bar{H}_{min} = \bar{\Delta}H + \bar{h}_a = -3000 + 3200 = 200 \text{ m}.$$

Since the value sought $h_a = \bar{H}_{min}$, then h_a sought = 200 m.

We have given only part of the working graph for the purpose of showing how a problem is solved. In case of necessity its size and scope of values may be enlarged. By using this graph it is possible to solve the above problems with an accuracy sufficient for navigational practice.

Maj. V. M. CHIKUL,
Military Navigator First Class

REVIEW AND BIBLIOGRAPHY

A COLLECTION OF ARTICLES ON THE TECHNOLOGY OF TRANSMITTING RADIO MEASUREMENTS FROM ROCKETS AND MISSILES

Recently a collection of articles dealing with the technology of transmitting radio measurements from rockets and missiles was published. [1]

Radiotelemetry — a field of technology concerned with the remote transmission of measurement data by radio facilities — is of fairly recent origin and is undergoing intensive development at the present time. Radiotelemetering systems are finding wide application in meteorological and geophysical measurements made by sounding balloons, in investigating the upper atmospheric layers and cosmic space by artificial earth satellites and cosmic rockets, as well as in testing aircraft and guided missiles, etc.

It is well known that any radiotelemetric system is essentially a specialized multichannel radio link. In line with this, the first part of the collection gives a classification of radiotelemetric systems, a description of methods of information transmission, a discussion of the principles involved in designing multichannel transmission systems, as well as the data for telemetric sensors and methods of reception and signal processing in radiotelemetry. In addition, there is a discussion of the selection of the wave range for telemetric systems, antenna designs which do not interfere with the aerodynamic characteristics of missiles and rockets, the selection of the type of system with examples of functional diagrams of radiotelemetric systems.

In describing the sensors, i.e., the devices which convert the physical magnitude changes into appropriate electrical signal changes, main attention is devoted to instruments which are most widely employed in practice.

The second part of the collection is devoted to the theory of information and the theory of errors in radiotelemetry. In it are included three magazine articles. The first article states briefly the theoretical principles of information, followed by a discussion of the application of this theory in radiotelemetry.

The authors analyze the discrete states of the measured magnitude, the entropy and the transmission rate of data from the source of telemetric information, the

1. Tekhnika peredachi izmereniy po radio s raket i snaryadov. A collection of translated articles from foreign magazines dealing with radiotelemetry, edited by V. K. Morozov, V. G. Pol' and T. A. Shmaonov. Military Publishing House of Defense Ministry of the USSR. Moscow, 1959, 128 pp., Price [illegible].

width of the bandpass, and the capacity of the telemetric system. There is also a discussion of the required ratio between the signal and noise level.

Of interest is the article dealing with the desirable conversions of radiotelemetric information from the point of view of the most effective operation of a radiotelemetric system having the least complicated equipment. The article analyzes the properties of the transmitted message and the parameters of the communication channel, and briefly mentions the effect of noise on the fidelity of message reproduction and the most effective ways of coding.

The first article in the second part leads us to believe that the radiotelemetric systems in use abroad have a rather low efficiency.

In present-day systems, the reception data most often appear as discrete values characterizing the measured magnitude at discrete time intervals which are usually equally spaced. In the operation of these systems, the problem is to set up continuous functions on the basis of analyzing the finite number of their values. As is known, such a problem belongs to the field of interpolation. The errors in determining the curve which characterizes the telemetered magnitude as a function of time are largely due to the effect of the frequency of information transmission, i.e., the number of interrogations performed by each sensor in a unit of time. The third article is thus devoted to determination of interpolation errors when the curves are plotted by the sampled measurement data. In the article is given an analysis of errors occurring in linear, circular and parabolic interpolation, as well as information on the results of experimental investigation of the problem of interpolation.

In the third part of the collection, there is a description of some radiotelemetering systems and components. It must be noted that, on the whole, the performance of the equipment described should be treated critically, since it may be slanted for sales appeal. This section of the collection is well illustrated and contains many schematic diagrams of subcarrier-frequency oscillators, transducers, temperature measurers, as well as schematic diagrams of transmitters. However, there are no operating descriptions given for the diagrams. For this reason, a reader unfamiliar with such diagrams will have difficulty understanding the physical processes they represent. The editors of the collection should have seen to it that such an obvious fault was eliminated.

The functional diagram of the receiver and low-frequency decoder filters of the 18-channel FM system is briefly analyzed, with certain parameters being given. There is also a description of a radiotelemetric system with a pulse-code modulation (KIM), giving its general functional diagram, the functional diagram of airborne equipment, as well as some data on the formation of code groups of transmitted signals together with photographs of a number of components. In addition, there is a rather detailed description of a receiving station, discussing the data-storing elements, the recording system for rapid scanning of radiotelemetric information, the conversion and programming devices and devices for the conversion of eight-place binary to a binary-decimal system. The latter is linked with the computer which processes the telemetric information.

At the present time the pulse-code modulation radiotelemetric systems are rather promising. But, unfortunately, the collection does not present the electrical circuitry of the various devices used in such systems.

The authors also discuss a radiotelemetric system for artificial earth satellites.

This system is transistorized and has coding and storage arrangements of magnetic cores with an orthogonal hysteresis loop. The principle involving the use of magnetic cores in coding and storage are discussed in sufficient detail.

The third part of the Collection contains two articles, one of which is devoted to radiotelemetric pulse-phase modulation transmitter, and the other to a demodulator for radiotelemetric systems of broadband frequency modulation. The transmitter is designed for medium-size rockets. The article deals in necessary fullness with the schematic solutions of commutation circuits, transmitter modulation, and the generation of calibrating signals.

The concluding part of the Collection is devoted to the employment of transistorized instruments in radiotelemetry.

One of the articles in this part discusses a three-channel radiotelemetric double-frequency modulation transmitter, designed for a 50.8 mm missile. Two channels are used for transmitting pressure and acceleration information, and the third for transmitting the missile's rate of rotation. The power is supplied to the transmitter apparatus from an audio battery which is sufficient for 15 minutes of operation.

In the article are given schematic diagrams of carrier and subcarrier frequency oscillators, as well as the principal characteristics of these oscillators.

It must be noted that the terms used in the Collection are not, for some reason, the accepted terms used in our own literature.

However, in spite of certain shortcomings, the book "Technology of Transmitting Radio Measurements from Rockets and Missiles" is of interest to a wide circle of radio specialists. We feel that the Military Publishing House has done a service by issuing the second — during the recent period — collection of articles on radiotelemetry.

Engineer Lt. Col. M. V. MAKSIMOV,
Docent, Candidate of Technical Sciences.

AVIATION ABROAD

(According to Data in the Foreign Press)

ELECTRONIC LANDING SYSTEMS

Regulating air traffic in the airfield zone and bringing aircraft in for a landing, especially when visibility is poor, becomes exceptionally important with greater speeds and higher ceilings. The rapidly changing aerial situation and all-weather flights demand solving a great number of technical problems. The necessity of solving them as quickly as possible is felt especially keenly when using the same airspace for a great number of aircraft.

The existing navigational systems used abroad do not, according to the opinion of foreign specialists, solve all the problems of regulating air traffic, but only enable the crews to determine the position of their own plane on a route flight or in the airfield area. For the purpose of setting up a uniform system of air traffic control (ATC), there is need for facilities which would gather operationally aerial situation information in a form which could be most easily used by a flight controller and facilities for processing this information and for transmitting commands to airborne aircraft. For the purpose of collecting information it is proposed to make use of the fully automatic surveillance radar or airborne autonomous and non-autonomous navigational facilities which will transmit data to control points through automatic links. Which one of the above principles will gain preference is difficult to predict. However, even now many foreign specialists feel that radar combining the passive work regime with the utilization of moving target selection working in conjunction with airborne transponders give the fullest information on an aerial situation. All the ATC centers in the USA, for instance, will presumably be equipped with improved surveillance radars. Also under consideration is the problem of the possibility of using radar stations in the early warning network and radars in airfield and AA system networks in order to eliminate duplication of operation and to create an ATC system working in close conjunction with AA defenses.

When the density of traffic in the airfield zone is very high and aircraft must be landing at 20-30 sec. intervals, simple non-automatic ATC systems cannot cope with such a problem — their capacity is too small for this.

For processing information on the air situation high-speed electronic computers here come to the aid of man. The necessity for such devices is felt especially keenly in the case of military jet aircraft, since any delay of aircraft aloft leads to unnecessary consumption of fuel and a reduction in their operational range.

According to the information in the press, especially in the magazine "Transactions" (July, 1959) electronic computers for ATC systems have already been developed and are being put into use.

Thus, in one American system for the automatic processing of flight data — "Ramac" — three computers are used. Two of these are used for introduction by the dispatcher of data on the flight schedule and for obtaining answers on the actual position of the aircraft. The third — the basic computer — records flight plans and evaluates the possibility of an emergency situation over control points.

Sometimes facilities for gathering and processing information and automatic links for transmitting commands to the aircraft are combined. As an example of such a device we may cite the "Volscan" air traffic control system designed for controlling flights in an air space "scanned" by a ground-based radar. This system regulates air traffic and vectors aircraft to landing headings at airfields within the effective zone of its radar. After this the aircraft are controlled by the landing systems of the airfield, which systems are being given special attention at the present time. American statistics show that the largest number of accidents occur during landing. Thus, during the three years of WW II the USA lost in combat operations about 7000 aircraft, while about 11,000 aircraft were lost as a result of accidents, the majority of which having occurred during landings.

Landing systems of two types have found the most extensive application abroad: radio-beacon instrument landing systems (ILS) and ground controlled approach (GCA). The first is widely used in civil and military aviation; the second is used basically for military aviation.

Moreover, the ILS system has been adopted as typical landing equipment by the International Civil Aviation Organization (ICAO).

Inasmuch as the first and the second systems make it possible, in principle, to automate the process of air traffic control of planes which are located within their operating zone, the modernization of the system is being conducted in this direction toward eliminating such deficiencies as low capacity, parametric instability of ground-based equipment (the technical performance being affected by the terrain, work stations, and weather conditions), the necessity of making a landing approach on a fixed glide path, and a number of other factors.

At the same time, new principles of setting up landing systems are being sought which will not only guarantee the aircraft's coming out to a visual contact range with the runway or the light check points outlining the runway, but which will also permit making the touchdown and taxiing on the runway automatic.

Special attention is being devoted at the present time to improving the characteristics of landing facilities for controlling aircraft landing in a vertical plane. According to information in the press, the "Rigel" system, under development in the USA, should eliminate the faults of the ILS glideslope radio beacon systems. In the vertical plane it will produce a "coordinate grid" in reference to which the aircraft position will be determined. During a landing approach, it will be possible, as the result of this, to come down on a glide path best suited for each type of aircraft (for each specific case).

There are in a number of countries operational electronic systems, each one making it possible to solve one or more navigational and traffic control problems, such as, determining the aircraft position on the route, vectoring it to the runway, regulating air traffic in the area of the airfield, etc. But as yet there is no combined system which solves simultaneously all the problems enumerated above.

In long-range radio navigation the most widely adopted systems are those using radio compass homing which make use of special homing stations as well as

powerful radio broadcasting stations. Well-known also are the hyperbolic systems of the Loran, Decca, and Dectra type. The principle of their operation consists in having a special airborne receiver with which it is possible to determine the aircraft's position as the point of intersection of two hyperbolas. Each one of the hyperbolas is the locus of all points of fixed time differences between the signals received from two pairs of ground stations (or three stations operating in pairs). The airborne indicator displays the numbers of the hyperbolas and the navigator finds on the chart the point of their intersection (Fig. 1).

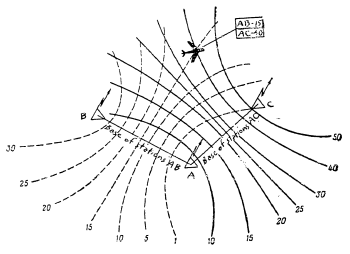


Fig. 1. Hyperbolic system.

The operating range of such systems, depending on the base of the ground stations, their power output, and the conditions of radio wave propagation, may reach 3000-5000 km. The accuracy of determining the aircraft's position is obtained from the intersection of the hyperbolas. In the various modifications of the Loran system the accuracy varies from 300 m to 4 km.

At the present time the hyperbolic systems are being brought up to date. The airborne equipment is combined with a self-contained Doppler systems which greatly increases its performance capabilities. By improving the Loran-C system the Cytac system was obtained. Its operational range goes up to 5000 km (three-dimensional beam), and the accuracy of determining the aircraft position to about 60-80 m.

In short-range navigation medium-wave homing radio stations are usually employed in conjunction with airborne radio compasses. However, their scope is limited by the fact that the navigation is done to the station away from it or around it. Azimuthal distance-measuring systems operating in the ultra-short wave range make it possible to fly on any flight route in reference to a radio beacon (determining the azimuth and range by reference to the installation point at any given moment). Thus by using the "Tacan" tactical system, an aircraft crew is able to determine with high accuracy its range and azimuth in reference to the point of

installation of the ground equipment. These data are fed into a computer, to the output of which a flight director is connected, making it possible to fly a plane on any flight path (straight and level or circular in relation to the ground station). The range of such a system reaches 370 km with a flight altitude of more than 10,000 m.

In the "Tacan" system, the range is determined by the time it takes the interrogation signals to travel from the airborne transmitter to the ground radio relay station and back. The azimuth is found by measuring the time lapse between the moment the maximum radiation pattern of the ground station's antenna is beamed to the North and the moment this maximum passes through the azimuth of the given aircraft. When the antenna's rate of rotation is constant the time lapse between the two indicated moments will be proportional to the aircraft's azimuth relative to the ground station.

In order to broaden the scope of the "Tacan" system's operation, and to unload the radio-telephonic communication channels, an automatic radio link, the "Tacan data link", was developed which insures the transmission of speed, altitude, and course data from the aircraft aloft to the controller. These data are transmitted to the ground automatically every 15 microseconds after the interrogation by the controller who can use 31 coded commands (for example, "Drop down to 1000 m", "Pinpoint the course", etc.). These commands are transmitted to the pilot by pressing the appropriate button on the control panel. The pilot in turn is able to transmit to the controller a coded measure. The system can serve simultaneously 120 aircraft, maintaining communications which are transmitted through links in the memory device. When the air traffic is heavy, the system transmits data only to those planes which are low on fuel. At the present time in the USA on the basis of a semi-automatic system of AA facilities control, "Sage", a new radio link is being developed which is designed to serve up to 500 aircraft simultaneously. It does not, however, solve the problem of regulating air traffic automatically, but will only unload the radio telephony channels.

When employing such radio links, in conjunction with a computer it is possible to obtain an automatic comparison of actual data with the flight plan and thus to spot an emergency situation.

The "Volscan" system of control can also serve as an example of equipment for use in regulating air traffic. It is composed of the following: surveillance and height-finder radars; fourteen computers for continuous computation of aircraft coordinates and the required flight trajectory; the distributing and control blocks; control posts. A version of a fourteen-channel system is manned by eight operators (three at the control posts and control panel and five for transmitting commands to the pilots). In the future it is proposed to make the transmission of commands to airborne aircraft automatic.

The principle of the "Volscan" system's operation is as follows. As soon as an aircraft appears in the zone, the operator points a "gun" at the blip appearing on the radar screen and pulls the trigger. The photocell of the "gun" picks up the light from the blip. As a result, signals appear which generate the so-called "gate" and thus "acquire" the target blip. Thus the blip of the given aircraft is isolated from the other aircraft. One of the channels tracks this aircraft, feeding its coordinates into the computer which in turn determines the trajectory of the

aircraft's flight and the time of its arrival at a given point. In the distributor the information is compared with the schedules of other aircraft and the shortest possible path of the desired point is determined.

The operational radius of such a tracking system is about 100 km; the handling volume (estimated) is up to 120 aircraft per hour. It is proposed to include the "Volscan" as a component part of the new "Tracal" system which is designed to automate all the operations of a landing approach.

Automating the aircraft's alignment with the runway and bringing it in for a touchdown by the ILS system is hampered by the fact that the glide slope can be formed only to an altitude of 9 m above the runway. The automation of landing is being developed by way of "extending" the glide slope through a special antenna zone in an area below 9 m or by programming the aircraft's letdown through an airborne computer utilizing the data from a precision radio altimeter.

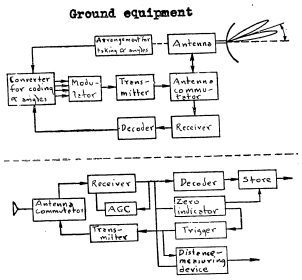


Fig. 2. Block diagram of the system.

In the opinion of American specialists, there are unexplored possibilities when glide slope radiobeacons are designed on the principle of a two-lobe scanning pattern (the "Rigel" system - Fig. 2). Such a system will make it possible to set up an optimum glide path for an aircraft of a given type within the limits of elevation from 1.5° to 20°, to control the descent of aircraft over a larger sector in the vertical plane. The system's performance is not affected by the terrain or other factors.

The automation of the AGCA system is performed by eliminating the controller, i.e., the process of generating commands and transmitting them to the aircraft is made automatic. In the ground-based system a computer and a radio data link are installed, while on the aircraft there is an apparatus for converting the commands received into signals for the indicator or the autopilot. The AGCA system so designed is intended for bringing out the aircraft smoothly to the minimum altitude required by the instructions. Here the accuracy achieved in bringing out the

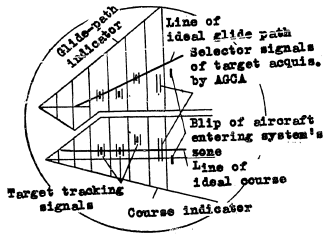


Fig. 3. Course and glide-slope indicator of the system.

aircraft at the end of the automatically controlled leg should enable the pilot to land by visual reference. The effective range of the system depends on the operating range of the landing radar and is about 16 km. The accuracy of glide slope is ±9 m at a 600 m range from the point of touchdown, course line deviation amounting to no more than ±15 m. A simplified schematic of the course and glide-slope indicator of the system is given in Fig. 3.

The AGCA system (Fig. 4) can accommodate simultaneously no more than six aircraft. Tests have shown that it controls automatically a continuous stream of aircraft, bringing them in to a 30 m altitude.

The automatic landing system AGCL (Fig. 5) is made up of three radars: search, precision landing approach, and landing. The data from the landing radars, after computer conversion, are fed to the aircraft's inertial system which responds automatically to command signals.

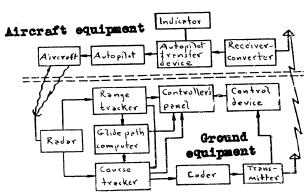


Fig. 4. Controlled landing approach diagram.

Another version developed by the Bell Aircraft Company automatically controls only one aircraft at a time, but it brings it to the runway right up to a touchdown or to a deck-landing on a ship without interference on the part of a pilot.

In addition to landing facilities, the air traffic control systems are equipped with airfield surveillance radars. They operate in the millimeter wave range of high resolution, making it possible to receive a clear picture of aircraft, motor vehicle, and even pedestrian traffic on the airfield.

We must note that not only in the USA a great deal of attention is devoted to the problems of air traffic control. Commercial and military interests are leading a number of West European firms to work in this direction. Thus, at the World Exhibition at Brussels a three-coordinate radar for operator-controlled air traffic was shown which was developed in France. Its operational range is 180 km, detection altitude is over 12,000 m (with range accuracy of ± 450 m, and altitude accuracy of ± 300 m). The system is equipped with a special device for automatic read-out of aircraft coordinates and converts radar to television display. This makes it possible for operators and controllers to work in a non-darkened room.

The Dutch firm "Holland Signal Apparaten" developed the "Satko" system of automatic air traffic control, which makes use of the currently available communications and navigational facilities for computing the time of arrival of the aircraft at preselected points. Similarly to "Ramae", this system anticipates the danger of in-air collision between planes, and, in a dangerous situation, it computes a safe course; but it does not resolve all the problems involved in controlling and landing aircraft.

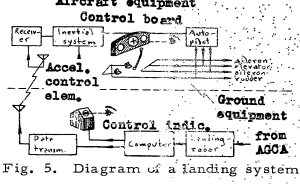


Fig. 5. Diagram of a landing system.

Thus, the problems of air traffic control and flight safety are given a place of major importance. At present, intensive work is in progress for the development of the most effective version which would satisfy the aviation interests of various agencies: AA defenses, the Air Force and civil aviation. The resolution of this problem lies in the direction of automating the traffic control of flight vehicles at every stage of flight and of complex employment of radio navigational facilities together with computers.

Engineer Maj. A. I. ZADOROZHNYY

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BRIEFLY ON MISCELLANEOUS SUBJECTS

How to Protect an Aircraft from the Effects of ... Ozone?

At first glance this question may seem somewhat strange. Is it really true that ozone, which we inhale with pleasure on ocean beaches and after a thunderstorm, may cause damage and that precautions must be taken against it?

"Yes", answers medicine. Even at concentrations over 0.0005 mg/l it begins to have a dangerous effect on man. Moreover, in stronger concentrations it destroys the rubber parts of aircraft.

Science has established that ozone is always present in the upper layers of the atmosphere. The strongest concentration of ozone is observed at altitudes of from 15 thousand to 25 thousand meters.

How is it possible to protect an aircraft and crew from the harmful effects of ozone?

First of all, it is known that at a temperatures of 257 - 270° C ozone completely decomposes. High temperatures are created in the compressor of an aircraft engine and therefore the molecules of ozone break down there. The opinion is expressed in the foreign press that, with mass flights at great altitudes, it will be necessary to provide for artificial heating of the air entering the cabin and make more extensive use of protective oxygen equipment for protecting the pilot from the dangerous effects of ozone.

ONE MORE PROBLEM OF HIGH-ALTITUDE FLIGHTS

The higher an aircraft rises, the greater — as we know — is the increase in the intensity of direct solar radiation and the less there is there of diffusion of the light created by the radiance of the sky. As a consequence of this, at high altitudes, even in the day time, the sky appears black and the stars shine brightly against its background.

As a result, during simultaneous observation of objects illuminated and not illuminated by the sun, a sharp light contrast is created; it seems that everything is either black or white, visible or invisible.

Glancing at his instrument panel, the pilot naturally sees clearly those instruments illuminated by the sun, while those instruments on which the sun's rays do not fall are enveloped in almost total darkness. In connection with this, the necessity arises of assisting the pilot with facilities which reduce the sharp differences in brightness at high altitudes.

There are different ideas as to how this may be done. Some feel that, in order to increase illumination of the instrument panel, the walls of the cockpit must be painted white. Others suggest installing screens inside the cockpit to diffuse the sun's light. Still others suggest artificial illumination of the instrument panel with flood lighting.

A CURIOUS OCCURRENCE

"In low-level flight", relates Hero of the Soviet Union B. Tikhomolov, "we came out over an expanse of the Kazakh steppes and skimmed along over a desolate plain, burnt by the sun.

"But now in the distance something seemed to flash. We approached a herd of animals. A few seconds more and we would overtake them. But suddenly, as if on command, the herd divided into two and fanned out over the steppe. Before us there was left only the single leader — a large goat with huge horns.

"Coming to a sudden halt, he sharply pivoted and, taking on a belligerent pose, he bravely awaited the foe.

"The roaring 'monster' rushed at the brave animal. The goat tensed up and when the plane almost covered him with its shadow, he sprang upwards and lunged with his horns... into the air.

"We zoomed up and, turning around, took a look at our hero. The handsome goat, pawing the ground with his hooves, was twisting his head in bewilderment as if to say, 'Where has the enemy gone?' Then, convinced that his enemy had 'fled in shame', he proudly raised his horns and rushed off to gather the herd."

A LANDING AREA ... ON THE ROOF

In the center of Warsaw a new eleven-story hotel, the "Grand Hotel", has been built. Henceforth the guests will arrive at the hotel via the roof. In five minutes a helicopter delivers them from the airfield to the landing area located on the roof of the hotel. Before this it used to take thirty minutes to make the trip from the airfield to the center of the city.

The "Grand Hotel" is the only hotel in Europe equipped with a heliport.

In the photo: A helicopter makes a landing on the roof of the "Grand Hotel".

THE READERS' TALK ABOUT THE MAGAZINE

The editors have received a considerable number of questionnaires from the magazine's readers in which there is an evaluation of the material published during the past year. Opinions are also expressed as to how to improve the magazine's quality. One opinion, expressed by a number of readers — A. P. Vorozhtsev, V. I. Dudnik, V. G. Cherkovskiy, A. V. Khryukov, N. M. Volkov, V. A. Grigor'yev, V. A. Yeliseyev, M. M. Sadovnikov, A. G. Oreshchenkov and others — has it that the magazine has been more satisfactorily answering the readers' questions — questions of pilots, navigators, aviation specialists.

Evaluated positively, in particular, are articles devoted to avigation and the combat employment of aviation under adverse weather conditions, to a number of problems involving the operation of aircraft, to reminiscences by participants in the last war, etc. The feature, "Advice to Element Commanders", published in each issue, was approved.

At the same time, the readers justifiably claimed that some articles still suffer from long-windedness and insufficiently set forth the foremost experience in teaching and indoctrinating aviators and the methodological skill of commanders and flight controllers.

There is insufficient analysis of experience in conducting the preflight preparation day, writes reader I. I. Bugayevskiy. It should be shown how in the units flight missions are joined with tactical elements, how pilots are taught tactical maneuvers at high flight speeds.

The readers suggest the publication of a number of articles on such subjects as inculcating instructor skills in element commanders; the interception of aerial targets in the clouds; experience in servicing radiotechnical equipment; new aircraft and rockets; the inclusion of sketches and stories about leading aviators, etc.

Reader V. A. Grigor'yev feels that more should be written about helicopter flying, reader M. M. Sadovnikov is interested in questions involving the operation of aircraft special equipment, work in the field of inertial systems, etc.

The suggestions expressed in the questionnaires have been taken into consideration by the editors for the subject plan for 1960. The editors thank the readers for showing an interest in improving the magazine.